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THE MULTIPLE-UNIT TRACTION SYSTEM.

The system of electric traction about to be installed upon the Alley elevated railway system in Chicago by Mr. Frank J. Sprague, which is described and illustrated elsewhere in this number, presents some features of great interest and novelty, and will doubtless be made a theme for much discussion by engineers interested in traction problems. Its novelty lies rather in the application of already well-known methods to electric-railway problems than in any inherent departure from existing plans, but the really radical character of the new system is suggestive of the great possibilities of electrical application, and an excellent illustration of its flexibility.

In brief, the system differs from others in use for the propulsion of trains in the installation upon each car of a similar motor equipment, and the application to this of a system of control, through the agency of pilot motors, which can be operated from any car. The individual cars are so arranged that any number of them can be grouped together into trains, which can be operated from any of the cars, or these may be used independently. A greatly increased factor of traction is realized in this way, and doubtless a considerable enhancement of the convenience of operation is also a result of this method. The flexibility of a system of this character, it must be conceded, surpasses that of any other that has yet been suggested, since without alteration of the schedule in suburban or interurban service the size of the trains can be increased or diminished according to the demands of travel, while at the same time the schedule itself can be varied at will, if desired. The features of the system, which are most apparent at a first glance, and which will doubtless be the most discussed, are the necessarily great complexity of the methods of control, the necessarily lower efficiency of the numerous small motors employed on the individual cars, and the danger of derangement of the whole by the breakage of the pilot apparatus or some of the parts of the rather intricate mechanism employed to perform the numerous functions necessary in such a control method. Leaving out of the question the small amount of current consumed by this auxiliary apparatus, the question of efficiency seems to be one of the most difficult in connection with the use of such a method of traction. It is possible that the loss of efficiency due to the small motors is counterbalanced by the gain in general operative availability secured through the sub-division of the motive mechanism. At the same time it is to be questioned whether the same availability cannot be secured by other and less complex methods.

The long experience of Mr. Sprague in this field, however, makes any critic of his methods hesitate somewhat in deference to his judgment. The great success which has marked the elevator system designed by this engineer, the methods of which are applied in this case to the propulsion of trains, tends to confirm the opinion that the new method will prove admirably useful for the service for which it is intended. It is too early to say whether or not the multiple-unit system will meet with very general use, although it is hard to conceive a system for elevated railways or suburban railways that more nearly meets the difficult operative conditions which surround this variety of traction service.

THE ALASKA-RUSSIAN TELEGRAPH LINE.

The article by Professor Reginald A. Fessenden in another column concerning the value of a telegraph line through Alaska, across the Behring Straits, and to Europe *via* the Trans-Siberian Railway presents a highly interesting subject for speculation. It can hardly be thought for a moment that such a line would not be highly valuable and probably very profitable. The difficulties that present themselves are not electrical or mechanical in their nature, but have to do rather with the Governments of the countries through which such a line would necessarily pass. If the strip of Alaska running down the Western coast were continuous and joined the northern frontier of the United States at Vancouver Sound, such a line could be constructed on American territory as far as the Behring Straits. Unfortunately, however, a considerable portion of it would be in British Columbia, and this, in time of war, might militate against the usefulness of the whole system. Again, at the western end of the line the wires would run of necessity many thousands of miles through Russian territory. The experience of those who have had to do with the Russian system of censorship and the inquiring spirit of the Russian police and other officials would hardly make a telegraph line through Russian dominions a popular avenue for a large variety of communications. The effect upon American trade that the building of such a line would have would probably be very large and very beneficial. It is a proverb that in the opening of a new territory the next best thing after building a railroad through it is to traverse it with a telegraph line. There seems to be no immediate prospect of a Pacific cable, although the contemplated annexation of the Hawaiian Islands may again bring this subject up for discussion. Of the two methods it is probable that the overhead line suggested by Professor Fessenden would be both less expensive to build and far less costly to operate.

As to the possibility of using a rapid system of machine telegraphy upon such a line it seems that all that would be necessary would be strong and reliable construction. There is no doubt whatever that machine telegraphy at fairly high speeds would be possible over a well-built line of this character. With cheap rates to Japanese and Chinese points the stimulus which such a system would give our Oriental trade would be marked, and would doubtless result in such an increase of business with these countries that the expense of constructing the line would be small in comparison with the increment in the profits derived. It is not probable that if such a line were built it could compete with the Atlantic cable for messages to points to Western Europe, but with cable rates as they are now to Chinese and Japanese points, and trade with these countries increasing daily, it cannot be long before the advantages of such a line as has been suggested will be seen by capitalists, and its construction made an assured fact.

VIBRATING THE EARTH'S CHARGE.

The daily papers in New York City the last two or three days have indulged in spasms of large type and staring headlines concerning the remarkable labors of an inventor who, some may begin to think, prefers that medium for his communications to the scientific world. It is stated upon the authority of the New York *Herald*, under a caption ten lines high, that Mr. Nikola Tesla is about to discharge upon the suffering world an electrical disturbance which, in the language of our esteemed contemporary, "travels on the alternating currents with which the earth and air are charged, at the rate of several million miles a second." It is also stated that "the disturbance from the machine is felt instantly all over the globe."

While we are not told whether the feeling accompanying the disturbance is pleasant or otherwise, it is to be inferred from the lurid language in which these remarkable results are made public that the cataclysmic forces of nature are to be unchained and go careering through the realms of the air at the will of the inventor. The solid earth is to be shaken to its foundations, and the very atoms of its rocky frame are to be jolted and jarred by the tremendous vibrations emanating from his laboratory. There should be some limit set to this sort of thing. A new danger lurks in the electrical charge of the earth. From time immemorial the old planet has gone along carrying its charge of electricity undisturbed, except by such minor manifestations as thunder storms and the like, but now all this is to be changed. The placid quiescence of the earth's charge is not pleasing to Mr. Tesla. He wants to shake it. He proposes to send his vibrations careering through the very frame of the globe. The long repose of its electrical charge is to be rudely disturbed.

This does not seem right. A solemn warning should be given to all experimenters who propose to do those revolutionary things. If any disturbance is to be created which will be instantly felt over the globe, it seems at least reasonable to enjoin the disturber until proper assurances are given that the nature of the feeling to which we are to be subjected is pleasant. At this season of the year, when we all have to contend with hot weather, it does not seem right that our electrical charges should be jolted and jostled at the irresponsible will of even a wizard.

Lest someone should make the mistake of taking this too seriously, it seems necessary to say that Mr. Tesla is probably more amused by the newspaper accounts of his work than anyone else.

GASOLINE MOTORS.

There is a peculiar field of usefulness for gasoline motors conneted with dynamos for isolated lighting in situations where a steam engine, for one reason or another, is not desirable. Recent improvements have brought these motors to a very high state of efficiency, and reduced to a considerable extent the dangers that formerly accompanied their use. They are now constructed so that they can be readily adapted for direct connection to dynamos of moderate speeds, and their regulation has been improved until it is comparable to that of second-class steam engines.

Gasoline is a fuel of high potential energy, and, used in an explosion motor, develops a considerable portion of this energy as useful work. Considering that motors operated by gasoline occupy comparatively little room, have no attendant boiler, dispense with coal storage and the disposition of ashes, and obviate the many nuisances connected with a small steam plant, it will be seen that their development is of the greatest interest to electrical engineers.

In places where haulage is difficult, as, for example, in mountainous districts, or in places where coal is sold at a prohibitively high price, it seems that these motors could be used with the greatest advantage. The storage space required for their fuel is far less than that required for coal for an engine of equivalent power. Indeed, a complete plant of motor with its dynamo and fuel, probably would not ocupy more space than the boiler alone of an equivalent steam plant. It is somewhat remarkable that with all these advantages the makers of gasoline engines have not more actively entered the electrical field. It seems very safe to predict that machinery of this character has a very successful future before it.

High-Speed Telegraphy in Connection with an Alaska-Russian Telegraph Line.

BY REGINALD A. FESSENDEN.

At the present moment, when the Pacific cable is being discussed, it is opportune to raise the question whether the day of long ocean cables may not be nearing its end.

It is a well-known fact that before the partial success of the first Atlantic cable showed that long cables could be laid and operated, a company had been formed to establish communication with Europe by an overland telegraph line via Alaska and Siberia. The operation of the Atlantic cable showed that this project was doomed to commercial failure, and it was abandoned, though a considerable portion of the line had already, I believe, been surveyed, Messrs. Pope and Kennan having been members of the surveying parties.

Quite recently, however, a number of circumstances have occurred which most materially change the condition of affairs, and, in the opinion of the writer, not only render the construction of such a line commercially feasible, but also promise large returns for the capital invested.

These circumstances are: First, the approaching completion of the Trans-Siberian Railway, which will bring St. Petersburg in telegraphic communication with a point on the Pacific not far from Behring Strait. Second, the discoveries of rich mines in Alaska, which will tend to further extend the settlement of that territory, and render telegraphic communication with Alaska a necessity. Third, the opening up of China in a much larger degree to foreign enterprise and capital, thus allowing such a line to tap the large business in India and Australia, China and Japan, which at present falls to the Eastern Telegraph Company.

Fourth, and a very important point, the rapid development of high-speed telegraphy, thanks to the labors of a number of gentlemen, prominent among whom must be mentioned Mr. Delaney. It may be safely stated that messages at the rate of 1000 words per minute can be sent over comparatively long lines without difficulty, and the problem of transmitting messages at that rate from New York to St. Petersburg is one which, thanks to the contributions which have been made to our knowledge of the working of long lines by Heavyside, Kennelly and others, is a comparatively simple electrical problem. Considerable new work would have to be done in the line of satisfactory relays for the five or six relay stations that would have to be established, and, in general, a breaking away from old lines, and the treating of the subject more from the standpoint of the power-transmission engineer than of the instrument maker; and the utilization of the valuable store of information in regard to line construction and maintenance which has been secured by American and Indian telegraphic engineers. There is quite a considerable number of men to whom the problem would present no especial difficulty, and all that is needed is a Field to take hold of the financial part of the work. When it is pointed out that this line could do the work of no less than twenty cables, while costing much less, that it would tap a large and lucrative and growing commercial business, and that there is only one short section—that from New Westminster in British Columbia to the Russian side of Behring Strait, where the route has not already been prepared, this deficiency cannot exist for long.

Fifth, the improvements in cables and in telegraphic transmission without wires.

Putting to one side the utterances of electrical fakirs about "wobbling the earth charge," the fact remains that there are at present three practical means by which messages can be transmitted without wires. The first is the electromagnetic-induction method first suggested, I believe, by Professor Henry, or at any rate about the time when he was living.

The second is the electrostatic-induction method, which has been used to some extent in telegraphing to moving railway trains, which method was developed by Mr. Edison. The third is Marconi's system of telegraphy, with an improved form of Lodges' ball transmitter and "coherer" receiver.

This gives us a method of getting across Behring Strait if it be found that the shore ends of the short cable which would otherwise be necessary could not be protected from moving ice. Personally, however, the writer does not believe that this would be necessary, but it is merely mentioned to show that even if trouble should be met with from the above-mentioned cause, we are still not without resource, though, of course, at present none of the above-mentioned methods permits of rapid telegraphy, and a number of stations would have to be used. Most cable engineers will, I believe, consider that the problem of shore protection from ice presents no especial difficulty.

Having pointed out these facts, the question remains: By what route should the missing link between St. Petersburg and New York be made up? The more natural suggestion would be to go up the Pacific Coast, between the Rockies and the sea, as the climate is much warmer there, owing to the influence of the Japan current. This route has already been partially surveyed, and there are still living some eminent electricians who could speak authoritatively as regards its advantages. There is an alternative route, however, up the Mackenzie and down the Yukon, which would be worth considering.

To recapitulate, an overland land line, with only one short stretch of cable, is now feasible as a means of communication between America and Europe, Asia and Africa. By the use of high-speed telegraphy and relay stations, one such line could be used to transact an amount of business, for which, at present, there would be required about twenty cables. To a great many points the distance would be shorter by this line, and the capital outlay less. There is at present, or will be in the near future, but one comparatively short gap to bridge—that between the southern end of British Columbia and the Eastern terminus of the north branch of the Trans-Siberian Railway.

Owing to the fact that at the moment the writer is out of reach of his collection of data, the exact relation between the capital expenditure of the present cable system to India and of the proposed overhead line cannot be at present furnished, but I hope to give a rough estimate in the near future,

It is believed that here, if anywhere, is the opportunity for high-speed systems of telegraphy. As regards the best system, that is at present doubtful, and Mr. Delaney is probably best qualified to speak on this subject. The electro-chemical recorder does not lend itself readily to relaying, but, on the other hand, with high voltages, which might be used with our improved methods of line construction, and borate of lead-glazed insulators, it would possibly not need more than one relay. It was pointed out by the writer in THE ELECTRICAL WORLD, for September 15, 1894, that: "It does not seem to have been generally noted that the sine curve is a necessity for efficient telegraphy. In January, 1891, I designed and experimented upon the system of multiplex telegraphy, which Dr. Pupin has recently discovered, and noticed this fact. As a result, a method was devised by which the operator did not make or break the line circuit with his key, but put in circuit a device which automatically sent out sine waves into the line." The recent admirable experiments of Messrs. Crehore and Squier (THE ELECTRICAL WORLD, May 8, 1897) show that this is the case. This opens up another system, and with good insulation, possibly a successful one.

It must not be forgotten that at present almost the entire cable traffic with the East emanates from England and other European countries. But with Lord Salisbury's policy we may expect that, when the present temporary inflation is over, that England will take a much less prominent part in the world's commerce than formerly. As Rome held the ends of the chain of commerce which bound together the lands of the Mediterranean, as England has until now been predominant on the Atlantic, so the commerce of the Pacific belongs to us. And as a first means to the securing of this, we must have a direct means of telegraphic communication.

Electrically Made Phosphorus.

It is claimed that the new phosphorus factory in England, in which the electric furnace is used to obtain the phosphorus from its ores, is to-day manufacturing more phosphorus than all the other factories in the world combined.

Penny in the Slot Meters.

The "penny in the slot" gas meter seems to be meeting with favor in London, as it is stated that one of the gas companies in that city has over 150,000 of these meters in use. As they are probably used chiefly by the poorer classes, who have only a few lights, but use them steadily, it would seem that the use of such meters in connection with electric-lighting stations would bring a good class of customers.

Electric Traction.—II.

BY M. H. GERRY, JR.

THE MOTORS AND CONTROLLING APPARATUS.

At the present time, direct-current series motors with series-parallel controllers are in all but universal use for electric railways. Shunt motors are in service in Europe to a limited extent, and alternating-current motors have been given a trial. The latter have advantages under certain conditions for lines of considerable length where there are but few stops. Alternating-current motors tend to run at a nearly constant speed, approaching synchronism, and do not regulate with the same facility and efficiency as direct-current motors. They develop, however, a good starting torque, and may even produce a better form of torque-speed curve than the common series motors. The double conductors required with alternating-current motors is an objection, but there are many advantages in their favor; the system is untried and its possibilities are not fully known.

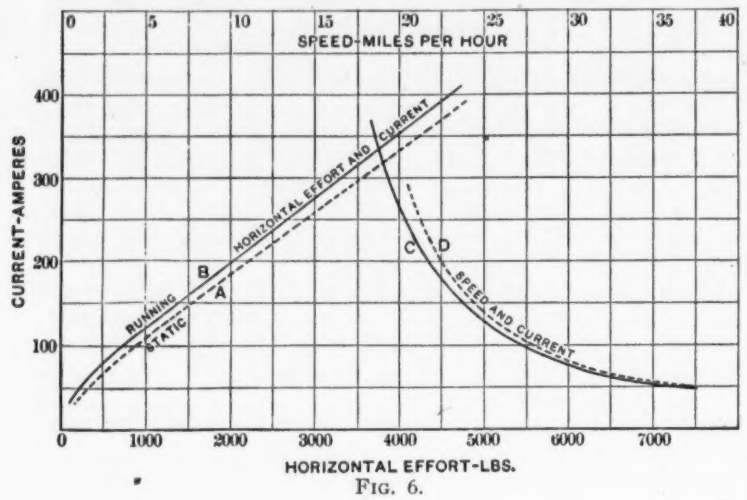


Fig. 6.

The characteristics of the motors in use on the Metropolitan Elevated are introduced in this paper rather than a general discussion, and it is hoped that this will be acceptable. By modifying the design the relations existing between the torque, speed, current and voltage may be varied within wide limits, but the general relations are always the same and are well illustrated by the diagrams below. All modern railway motors are much alike, the designers having been forced by the conditions imposed upon them, into practically one general type of machine. The requirements are a large output, ability to withstand heavy overloads, freedom from sparking, a low rotative speed, light weight and limited space. The result is the cast-steel multipolar motor, operating with nearly saturated fields and high magnetic densities in the armature.

In electric motors, the relations between speed, horizontal effort (or torque), current, voltage, and efficiency are all fixed, and may be readily determined for any particular motor. For most practical purposes it is best to represent these relations graphically. At *A*, in Fig. 6, the relation between current flowing and the static horizontal effort produced, is shown for the standard motors in use on the Metropolitan Elevated Road. Curve *B*, in the same figure, represents the horizontal effort produced when the motor is running with 500 volts at the terminals and at the speeds shown by *C*. The horizontal distance between *A* and *B* represents the loss in horizontal effort due to friction and core losses. Curve *D*, in the same figure, gives the speeds which the motor would attain under the conditions named if there were no internal resistance, and the horizontal distance between the latter curve and *C*, represents the loss in speed due to such resistance. Thus the losses in a series motor may be divided into two classes, those that lessen the torque and those that reduce the speed. In Figs. 7 and 8, the relations between current, speed, and horizontal effort are plotted for the same motor at 250 and 125 volts. The static horizontal effort is the same in all cases, but the running horizontal effort is slightly greater for the same current at the lower voltages, because the losses which affect it are less at the lower speed. At the same time the percentage of loss due to internal resistance becomes greater, as it depends upon the current flowing, while the total input of energy varies with the electrical pressure as well; hence, the reduced efficiency at the lower voltages. Curves of efficiency, in relation to the current, are plotted in Fig. 9 for the same voltages. In Fig. 10 the efficiency is plotted to the speed, and it will be seen that the curves fall off rapidly above or below a certain narrow range of speed over which the efficiency is high, at any one voltage. There is a considerable range of current and horizontal effort, over which the efficiency is high, as can be seen from Fig. 9, but it corresponds to only a small speed variation. The relations of speed to horizontal effort are given in Fig. 11. The maximum working range of the motor is from 350 to 4000 pounds horizontal effort, and the total speed variation on this range at 500 volts will be about 14 miles, and at 250 volts, about 10 miles. The range of speed obtained in service at any one voltage is practically about one-half this amount, and if 250 and 500 volts be considered as the pressures at the motor, in series and parallel combination, then the total range of speed, without further alteration of the voltage by resistance in circuit, will be about 12 miles over a total speed range of 34 miles. For each combination of motors in series parallel, there is a certain range of speed over which the efficiency is equal to that of the

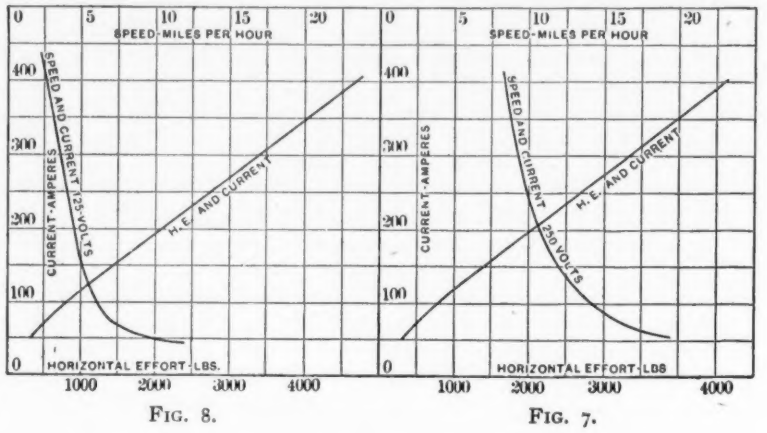


Fig. 8. Fig. 7.

motors; but at all other speeds, resistance must be introduced in circuit and the efficiency is reduced.

The weight of the armature and other revolving parts is a feature of importance in motors designed for a high-speed service, requiring frequent stops. These parts should be as light, and the rotative speed as low as possible. The armatures of the Metropolitan motors weigh approximately 1400 pounds and are 18½ inches in diameter. At 800 revolutions per minute, corresponding to 25 miles per hour, the kinetic energy in each armature is equal to 43,000 foot pounds. Thus, for a two-motor

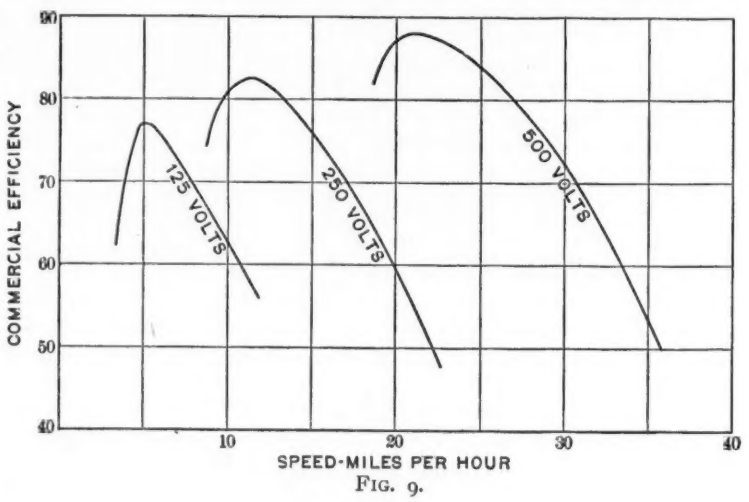


Fig. 9.

equipment, 86,000 foot pounds of energy are dissipated each time the car is stopped from a speed of 25 miles per hour. This amount of energy will vary with the square of the maximum speed and if stops are frequent, it becomes an appreciable loss.

The average load a motor is capable of sustaining is fixed by the permissible increase in temperature. The amount of such increase will depend on the average load, the efficiency of the motor and the extent and character of the heat radiating surfaces. The actual load on a railway motor differs at times very widely

from the average load, and ability to withstand these fluctuations will depend in part on the heat storage capacity of the motor. The metal acts, to a considerable extent, as a reservoir of heat, receiving it when the motor is doing its heaviest work and giving it up at lighter loads. A glance at the load diagrams in the latter part of this paper will serve to show how great these fluctuations may be under certain conditions. The amount of heat radiated in a given time varies greatly with the speed of the car and the temperatures. With the air at 60° F., and under average working conditions, a Metropolitan motor will radiate heat at the rate of about 650 British heat units per minute. This is equal to

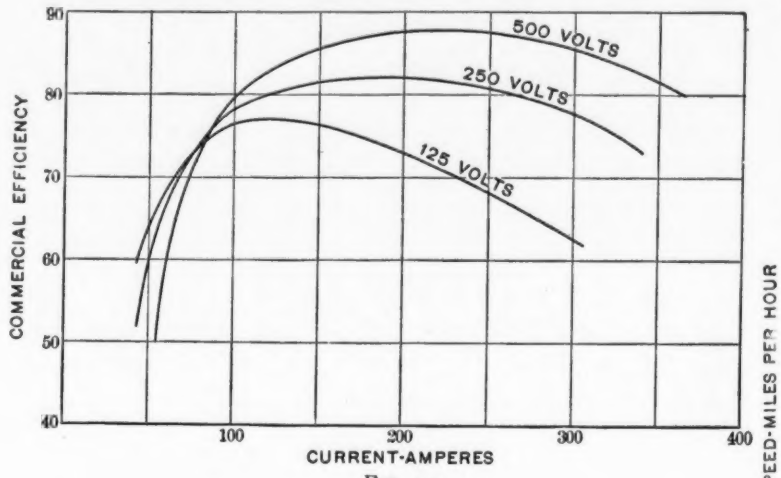


FIG. 10.

15 horse-power, corresponding to about 60 horse-power of loading. But these motors will readily withstand for a considerable period of time a loading of three times this amount. Most of the heat produced by this additional loading must be stored in the metal of the armature and frame. A considerable part of the heat is generated in the armature, but its thermal capacity being nearly 150 heat units per degree, a large amount of heat energy can be stored before the temperature reaches the danger point. Slow speed armatures in general have more metal in them, and are thus better able to stand a variable load.

The speed of a series railway motor at any given impressed E. M. F. is fixed by the total resistance of the train. The horizontal effort developed must just equal the resistance, or the velocity will change; therefore, if it be desired to maintain a constant speed, or to vary the velocity in any manner not corresponding to the fixed relations of speed and torque for the particular motor and voltage, it will be necessary to alter the impressed E. M. F., or to commutate the fields. To obtain this variable E. M. F. at the motor terminals from the constant E. M. F. of the line, many arrangements have been proposed, but only two are in any use to any extent. They are by rheostat in the main circuit, and by grouping two or more motors in series and parallel combinations. Practically the two methods are combined, and are now in nearly general use. The rheostatic method wastes the energy represented by the reduction in voltage, and the series-parallel arrangement provides two or more voltages at the motors without preliminary loss. The controllers in use on the Metropolitan are two combination series-parallel, and have three steps on the rheostat for each voltage. The losses in this apparatus vary from 10 to 20 per cent., depending upon the skill with which it is handled. With care this can be kept down to 10 per cent., making no allowance for the reduced efficiency of the motors at the lower voltages. The series-parallel system has decided advantages over all other methods thus far tried in practice, but it lacks flexibility, and ultimately may not prove to be the best for heavy railway work and especially for high-speed service.

The selection of the proper motors and controlling apparatus for a given service deserves more attention than it has generally received. The horse-power and maximum speed have too often been the determining quantities. A rating based on horse-power is now understood to be of little value, and the maximum speed of which a motor is capable may be of still less account as representing its performance with a train. Quite generally, motors have been speeded too high, the result being insufficient starting torque, a poor commercial efficiency and less average speed than a better selected motor would have developed.

THE GENERATORS AND FEEDER.

Anything like a complete discussion of modern railway generators or of the problems connected with railway feeders, might well be the subject of a separate paper. It is designed here simply to touch upon a few points relating to the general system.

Railway generators at the present time are nearly all of a direct-current type, but there is reason to believe that in the future two and three-phase alternating-current machines will be installed. The development of the rotary transformer will be largely responsible for this change in practice. Power stations can be more favorably located in respect to fuel and water supply, and through sub-stations furnish power to larger areas. With this change will come

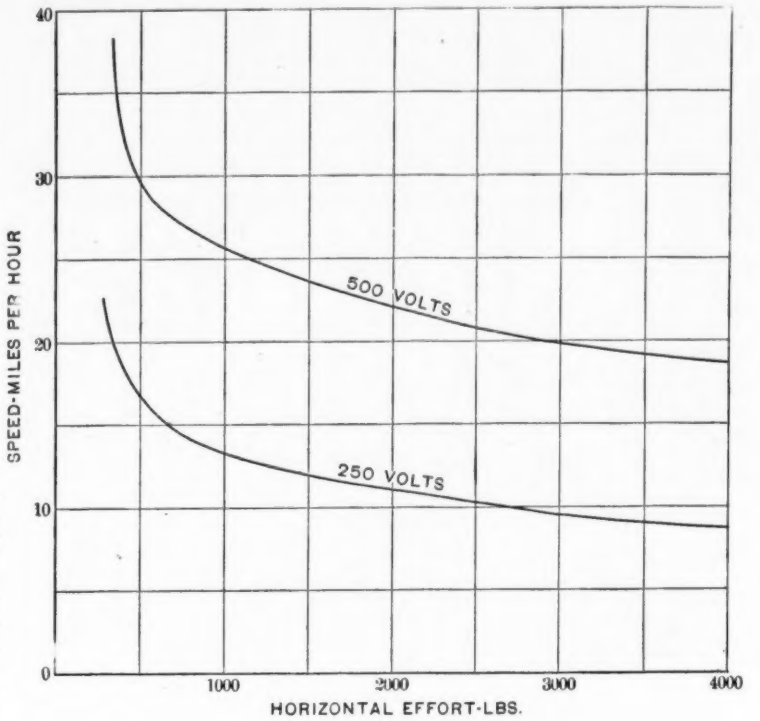


FIG. 11.

also greater economy in the production of power, which cannot but have a favorable effect on the development of the electric railway.

The commercial efficiency of railway generators varies from 90 to 95 per cent. Under favorable conditions, the average or "all-day" loss for large direct-connected machinery (units of over 600-kilowatts) is about 7 per cent. Direct-connected, alternating-current generators give about the same efficiency as direct-current generators. Commercially, the best results are obtained with a few units of large size. It is unnecessary and poor practice to install many small units for railway work.

The load line of an electric railway is subject to two kinds of fluctuations; first, those sudden changes caused by the starting together of a number of trains, and, secondly, the more gradual change due to the variation of traffic at different hours of the day. On roads operating but few cars, the fluctuations due to the first cause are of considerable amount, but on large systems with many cars the changes in loading from starting up of trains are very slight—hardly noticeable, in fact—and this is especially the case if the feeders are tied together and form a network. There still exists, however, the change in the load line corresponding with the traffic. A railway load line differs from that of a lighting station in having two nearly equal "peaks" or points of maxima, one in the morning and one in the evning. These variations are best taken care of by cutting in and out units, while the momentary changes can usually be cared for by a slight overloading of the machinery. Engines and generators for railway purposes have a good efficiency over quite a wide range and generally stand overloads very well. In Fig. 12 are shown seven load curves from the power station of the Metropolitan Elevated. The curves correspond to the days of the week, and indicate the average power taken, but do not show momentary fluctuations, caused by the movement of trains. The chief characteristics of these curves are the two decided "peaks" occurring daily with great regularity. The peaks vary as to the amount and time, with the season of the year, and to some extent with the

weather, but are always present in a marked degree. Street railway systems with many lines extending to different parts of a city, usually show a station load with less decided and broader peaks. This is due in part to the habits and occupations of the patrons of the various lines, which determine the hours of maximum traffic. When combined, the load curves from a number of such lines will give a more favorable station load than any one line or group of lines in the same section of a city.

The load curves of the Metropolitan have proven to be a very sensitive index of the traffic. A delay on the competing cable lines or increase of travel from any cause is at once noticeable in the power house. The greater station loading is due not so much to the increased weight in passengers carried, as to the longer stops necessary to discharge and to take on passengers; thus requiring a higher speed to keep the trains on time.

The feeder system has an effect upon the form of load curves as

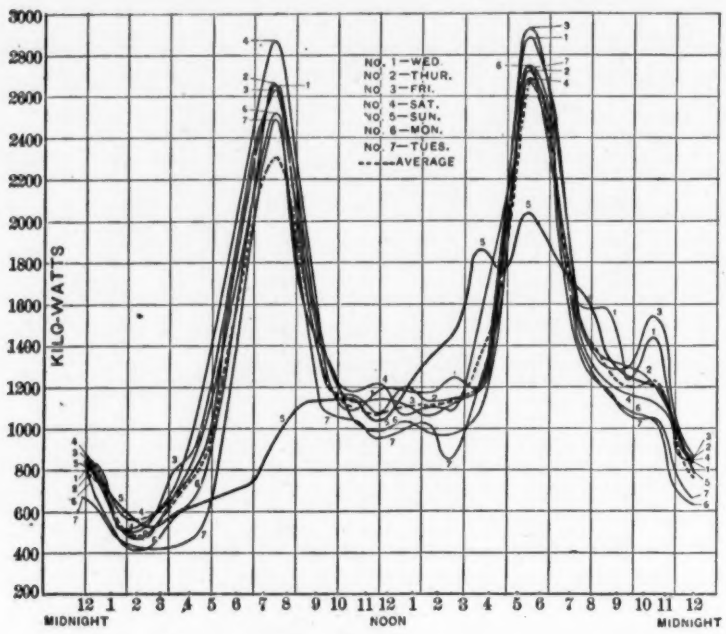


Fig. 12.

well as upon the total amount of energy required. The highest percentage of loss will occur at the moment of greatest loading, but this rarely take place at the same time on different sections, and an advantage is obtained by connecting the lines together to form a net work as far as possible. Feeders are usually divided into sections as a matter of safety and convenience. The best economy of copper and of power, and the most favorable load lines are obtained when the number of such sections are as few as consistent with the safety and flexibility of the system. When feeder sections are connected, the best practice calls for a fuse or circuit breaker in this circuit. The permissible percentage of loss between the power house and the trains is partly a commercial question, depending on the cost of power, and interest on the feeder investment, transformers, rotary converters, boosters, batteries, and similar apparatus forming a part of the feeder system, should be considered with special reference to cost, operating expense, all day efficiency and effect on the load factor of the generating station.

THE EFFICIENCY OF TRANSMISSION.

The energy dissipated between the engine and the car axles may be divided into three parts, that lost in the electrical generators, the losses in the transmission lines (including transformers, rotaries, etc.), and the losses in the car-controlling apparatus and motors.

The amount of loss in the generators will depend upon their efficiency and average loading. Modern railway generators have good efficiency above half load, and in stations designed with reference to the load line, there is but little difficulty in keeping the machinery above three-quarters at all times.

With machines of this type and size the all-day efficiency ought to be about 92 per cent. A sub-station provided with rotaries and static transformers working under a good average loading, should have an efficiency of about 89 per cent.; a loss of 8 per cent. in the rotaries and 3 per cent. in the transformers. The sub-station apparatus is at its highest efficiency at the time of greatest loading, when the feeder lines are at the lowest efficiency and thus have a favorable effect on the load line.

The losses on railway feeders vary from 10 to 25 per cent. Often there is sufficient copper if rightly distributed and tied together to reduce this at least one-half. Such a change would also improve the load factor and increase the efficiency of the station. The losses in the motors and car apparatus have already been referred to in this paper, but actual data and tests are here introduced in evidence.

From a large number of tests made on the trains of the Metropolitan Elevated Road, the following have been selected as illustrating this part of the subject. The trips are numbered from one to eight, and in the table below the data for each trip are given, together with the general results obtained. All of these runs were made on a dry track, in moderate weather and under average working conditions. The total electrical energy at the train was measured by Thomson recording wattmeters and the voltage and current by Weston instruments. The velocity record was taken from a Boyer speed recorder, and the stops and average speed from a double set of stop-watches. The pressure at the station was measured by a recording voltmeter.

Trip No. 1 was made from Franklin Street over the Logan Square line with a four-car train, heavily loaded, making an average running time of 13.27 miles per hour. The maximum grade on this line, going west, is 0.75 per cent., ascending for about 2350 feet, and descending for about 1950 feet. Other grades do not exceed 0.03 per cent. and only extend short distances. Current and speed diagrams on a time basis are plotted in Fig. 13 for trip No. 1. The current is the total amount taken by the train for power, and an inspection of the diagram will readily show the point of passing from series to multiple. The amount of energy required or absorbed by the train is as follows:

	Foot Pounds.
Total energy for accelerating the train	30,940,000
Total energy for train resistance	14,110,000
Total energy for grade	3,400,000
Total energy required for propelling the train	48,450,000
Per cent. of energy for accelerating	63.9
Per cent. of energy for train resistance	29.1
Per cent. of energy for grade	7.0
Time of trip, including stops	28 min. 26 sec.
Average horse-power required for propelling train	51.5.
Average amperes of current	138.25.
Average volts at train	504.
Average watts at train	69,678.
Electrical horse-power transmitted to the train	93.4.
Average volts at the station	545.
Average watts at the station	75,346.
Electrical horse-power at the station	101.
Effciency from electrical generators to car axles	51 %

Assuming the commercial efficiency of the generators as 93 per cent., the total power required at the engine shaft to propel this train is 108.5 horse-power.

Trip No. 2 was made with a four-car train, under similar conditions to trip No. 1. A current curve on a time basis is given for this trip in Fig. 14. In all of the current curves, it is easy to distinguish by inspection when the motors are in series and when in multiple. The stops on the controlled are also distinguished by the greater peaks on the curves. The smaller peaks and other irregularities are due, principally, to changes in voltage, caused by other trains in the same section, taking more or less current.

Trip No. 3 was made under similar conditions to trips 1 and 2, and the data and results are given in the table.

Trips No. 4 and 5 were made with heavily loaded three-car trains, and the results are set forth in the table. Both the speed and commercial efficiency of apparatus are higher than in the case of the four-car trains. A diagram of current on a time basis for trip No. 4 is given in Fig. 15, and a speed curve on a distance basis in Fig. 18.

Trips No. 6 and 7 are with two-car trains and show a higher speed than attained in the case of the three and four-car trains. The greater amount of power consumed in trip 7 is due, mainly, to the increased speed over trip 6. A current curve for the latter trip is shown in Fig. 16, and a speed curve in Fig. 17.

Trip No. 8 was made with four loaded cars, and the motors operating only in series. Both the speed and current are less than for similar trips with the motors operating in series and multiple. The percentage of power saved is greater than that of the reduction in speed, but this is due, not to a better efficiency of the apparatus at lower speeds, but to the fact that the amount of power required to propel a train making many stops decreases more rapidly than the average speed. The current diagram for the trip is given in Fig. 17.

The amount of power lost in the machinery and line, as indicated by the commercial efficiency of the apparatus given in the table, might seem at first thought to be large, but considering the transformation and the distance of transmission, it is certainly not excessive. The loss in this respect is offset by the smaller cost of producing energy by power-house methods. The train weight also may be reduced with electric power to a point impossible with steam locomotives, and the rate of acceleration increased, and thus a saving effected in power used at the train. While this does not improve the efficiency of the transmission, it reduces the total amount of power required, and as a feature of the system it should be given due credit.

Electrical energy can be produced in the vicinity of Chicago, with cheap coal, under the conditions of a railroad load, at less than half a cent per kilowatt-hour, and in the form of mechanical energy at the car axles, costing about 1 cent per kilowatt-hour, it is several per cent. cheaper than it can be generated by steam locomotives. Add to this the actual saving in energy from a more rapid acceleration and from reduced train weight, and the total direct advantage for the electrical system is obtained, as far as economy in power is concerned.

While any reduction in the cost of power (not only for fuel), but repairs, labor, water, oil and waste, etc.) is of great importance to railroads, the many other advantages of electricity, representing betterments of the service and greater earning capacity are the chief qualities which will determine its adoption in any case in place of steam locomotives. As a motive power electricity is simple, efficient and wonderfully flexible, and it is hardly wise to predict its limitations.

Meeting of Fire and Police Telegraph Superintendents.

The second annual meeting of the International Association of Fire and Police Telegraph Superintendents will be held at Nashville, Tenn., on September 14 and 15 next. The headquarters will be at the Maxwell House, and according to the circular announcement of the meeting, just sent out by President F. C. Mason, of Brooklyn, business of the utmost importance will be transacted. Valuable papers will be read touching upon many important subjects connected with the daily business experiences of these officials.

Accumulators in Central Stations.

From the carefully prepared table of statistics published in a German contemporary it appears that 80 per cent. of the continuous current stations in that country are provided with accumulators, the total output of which is 31 per cent. of the whole power of these stations. Notwithstanding such figures as these there are many American electrical engineers who still doubt the advisability of installing accumulators in connection with central stations.

Who Owns the Jungfrau?

This interesting inquiry was recently brought up by the projectors of the Jungfrau railway, who, before going ahead, were desirous of applying for permission in order that there might be no question of damages in the future. The boundary line between the cantons of Berne and Volais, which cuts the Jungfrau in two, has never been surveyed, and so far it has been impossible to determine the owner of the mountain.

Electric Light in the Royal Gorge.

According to a dispatch from Canyon City, Col., the officials of the Denver & Rio Grande Railroad Company have decided to illuminate the famous Royal Gorge with electricity, the current being furnished from the city. This is to be done for the benefit of travelers whose business makes it necessary for them to pass through the gorge in the night.

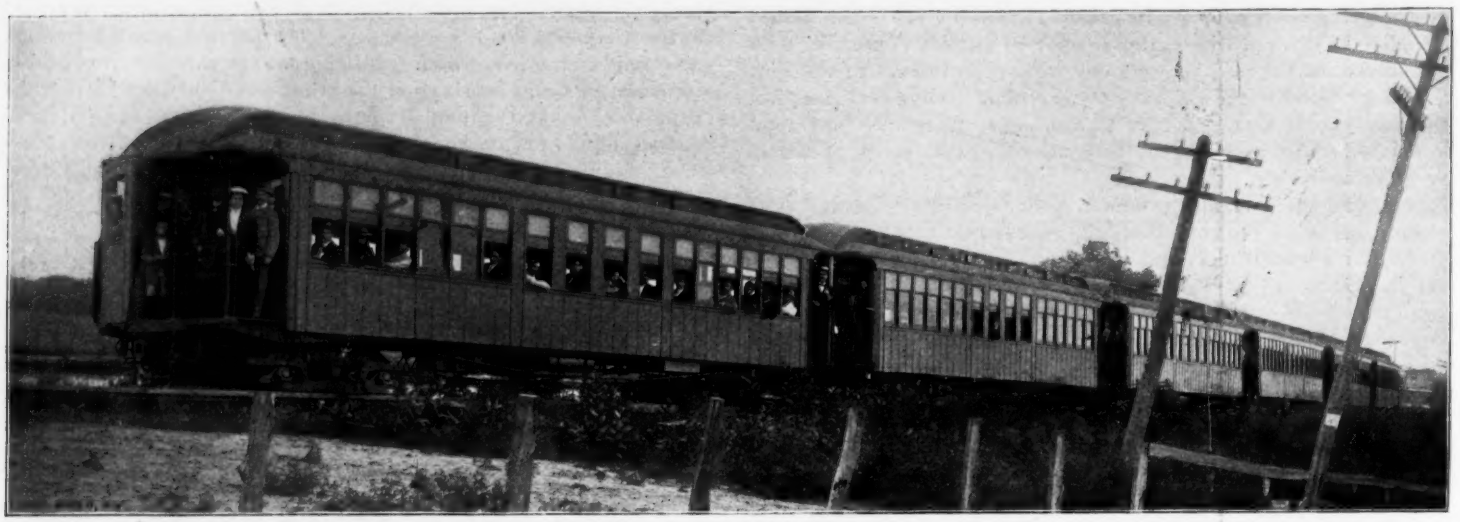
The Sprague Multiple Unit Electric Railway System for the Chicago Alley Elevated Railroad.

It seems scarcely conceivable when we contemplate the present status of electric traction that but a decade ago the first actual commercial electric street railway was still in a more or less embryonic condition. The Richmond electric street railway system, that epoch-making achievement in the history of applied electricity, was then about completed. It had not yet, however, been commercially operated. On the successful achievement of this pioneer undertaking, Mr. Frank J. Sprague laid the cornerstone of the electric street railway, which to-day contains all the essential elements of the Richmond road. Again has Mr. Sprague attacked the electric traction problem after several years devoted to the solution of another problem. As is now probably well known, the contract for the electrical equipment of the Chicago Alley elevated railroad system was recently awarded to him. It is but two or three months, however, since he began work upon the initial equipment for this road, calling to his aid the united forces of the Sprague factory, the Schenectady works of the General Electric Company, the McGuire Manufacturing Company, and the Standard Air Brake Company, each of whom furnished their particular element in the combined equipment. Actually, however, the entire train equipment was evolved within the past month. Under Mr. Sprague's personal supervision the evolution of the new multiple unit train progressed as if by magic. The middle of July saw the initial equipment and trial of two cars so equipped, and on Monday, July 26, the first public trial and run of a complete six-car train equipped with this new system took place in the presence of a number of representatives of the South Side Elevated Railway Company of Chicago, and other prominent railroad men and engineers. The railroad company's electrical engineer, Mr. A. D. Lundy, closely investigated this sample equipment and expressed himself most favorably. The entire equipment of the Alley road will in general follow the lines of this initial train, but will embody many modifications and further improvements.

FRONT OF CAR, SHOWING CONTROL HANDLE.

It is now more than ten years ago that Mr. Sprague first proposed the operation of multiple car trains, each unit of which was separately propelled by its own motor, each forming in fact a distinct and separate self-contained motor car which could be operated as a single unit or any number of which could be combined in a multiple unit train, the various units of which were all syn-

chronously controlled from one of their number. The Sprague Company began experiments in 1886-1887, on the Thirty-fourth Street branch of the Manhattan Elevated Railroad in New York City, with a single-standard elevated railroad car whose complete equipment consisted of two 15-hp motors, mounted on a single pivoted truck at one end of the car. At about the same time another large car was projected, whose equipment was to consist of four 75-hp motors and which really was the forerunner of the present locomotive car. The conception of the present system probably took root at about this time. Its many features have been advocated against what may even be called opposition until the evolution of the present methods of control and operation, whose promising possibilities warranted the choice of the Sprague multiple unit system for the Alley road even long previous to the recent trial. This clearly demonstrated that the selection was a most happy one, as the results obtained unquestionably indicate many features of great superiority. Motor cars or locomotives vs. individual motor units is a problem which now must be solved by actual results and comparisons.



Six-Car Electric Train on Trial Run.

The individualizing of each separate car, permitting the combination of any number to form a train, each car of which retains its individuality and independence, but all of which, when so combined, acting in unison, is in most striking contrast to the single propelling unit or locomotive plan. The possibilities of the latter are decidedly limited—the former almost unlimited. The operation of a road by the locomotive plan necessitates the closest consideration of the hauling motor element, the limitations of which distinctly mark the possibilities of such a system. On the other hand, where each car has simply to take care of itself, operating conditions and requirements regulate the movement of the rolling stock instead of the reverse, as in the first instance. Before dealing with some of the peculiar advantages inherent in the multiple unit method, the equipment of the present six-car train merits some description.

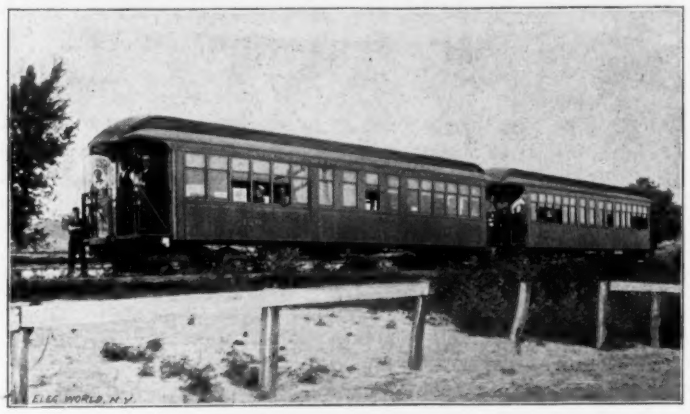
For this trial train six standard 42-foot elevated railroad cars were taken from the rolling stock of the "Alley" railroad system. These are almost exactly similar to the cars used on the New York elevated roads. The cars were each equipped with a single McGuire truck at one end, the old truck being retained at the other. Two "G. E. 57" motors were fitted to the new truck, one to each axle. These motors are the first of this type. They are rated normally at 50 horse-power, with a capacity of twice this amount when necessary. In general design they are ironclad four-pole machines, similar in design to the other G. E. motors, and are single reduction geared to the axles. Beyond this motor equipment the remainder of the electrical mechanism on each car differs quite radically from present methods. It is here that the Sprague controling system came into play.

An examination of the cars at once discloses the fact that the usual double-direct hand-operated controllers, usually placed on each platform, are absent. Instead of these appliances, each car platform is equipped with a small operating switch enclosed in a circular box mounted on an upright pipe. The motors on each car are controlled from either end of the car by a single controller, which is in turn governed through the medium of these operating switches. Series-parallel control is used, and the present driving-motor controller is of the well-known G. E. type, with separate reversing cylinder and magnetic blow out. Five of the cars have it placed under the side seats at one end of the car, where it is out of sight and entirely enclosed, while in the other it is placed inside of the platform canopy at one end of the car. In the latter position it can readily be reached without disturbing the interior of the car. This arrangement has been adopted as a standard. In its finally perfected form the controller will be mounted on a downwardly swinging trap door, which, when closed, brings the apparatus up into the canopy space. The entire controlling apparatus is therefore within immediate reach of the operator. The direct working of the controller is accomplished through a pilot motor and certain operating magnets, whereby the speed cylinder is moved to the desired position and the reversing cylinder moved in either direction to give the necessary connections for the desired direction of movement. A number of wires is the only medium connecting the mechanisms with the operating switches at each car platform. These latter devices have also been varied in construction on the various cars. On the left of the illustration showing the car platform one of them may be seen. The upright is simply an iron tube carrying the wires, on top of which is mounted a round box about 10 inches in diameter by about 4 inches in height, to the centrally projecting spindle of which a removable handle may be attached. Inside of the box are several contact blocks on each side of a central normal position to which the handle is always automatically returned by suitable springs. A push-button operating mechanism, similar in principle to that used on the Sprague elevators, has also been used with great success. This operating device is really the only visible means for handling the cars, whether singly or in train, and is the only mechanism with which the motorman produces all the necessary movements and speeds both forwards and backwards.

Some peculiarities of this controlling system may be noted. Primarily the motor controller and operating device used by the driver are electrically independent, and by a peculiar combination of mechanism the actual operation of the driving motor controller is automatic, not only under ordinary conditions, but also guarding against accidents and unnecessary and careless operation. A movement of the operating handle to either side causes a corresponding operation, by a suitable connection of the pilot devices, of the controller giving a forward or backward car movement, and speed depending on the extent to which and how the handle is moved in either direction. It is essential that the operator should always retain his hold of the handle, as the latter when released returns at once to the normal position, bringing the other devices to the same point and cutting off the current from the motors. When the operating handle has been brought to any one of the operating points to give any particular speed, the resultant movement of the pilot-controller operating machines is automatic, irrespective of the handle. If brought forward or back to produce other corresponding results, the controller follows. Intermediate speeds between the section of the operating switch are attained by variable length of contact. Should the current supply cease, suitable automatic means will prevent the restarting of the motors, irrespective of the operating device and the position of the controller. The latter will

be first automatically returned to its normal position, and then gradually come back to where it was when the current supply was ruptured.

Each of the cars embodies exactly similar elements and from underneath both platforms of each car hangs a small flexible cable having at its end a peculiar coupling. The couplings are entirely universal, so that either end of the car can be electrically coupled to either end of any other. These coupling wires connect with the pilot control and operating mechanism only. This connection



TWO-CAR TRAIN.

may be carried out through two, three, or in fact any number of cars, thereby connecting all the controller-operating mechanisms of the various cars together, and thereby making it possible to control the motors of all the cars so connected in exact unison from any one of the various operating switches on the different car platforms. It is immaterial which ends of the different cars are coupled together. The various operating pilot devices are all so connected that the same movement in anyone of the operating switches will always cause the corresponding motor operation in all the cars connected. It may be noted that this coupling is very easily made, even at the present time, although in the future automatic electric couplers will be used. It is entirely immaterial, also, which operating device is used. The train can be run from the centre, from either end, or any platform, equally well in either direction and at any speed. The peculiar flexibility of this operating apparatus was shown during the test, when one car in which readings were taken was additionally equipped with a push-button op-

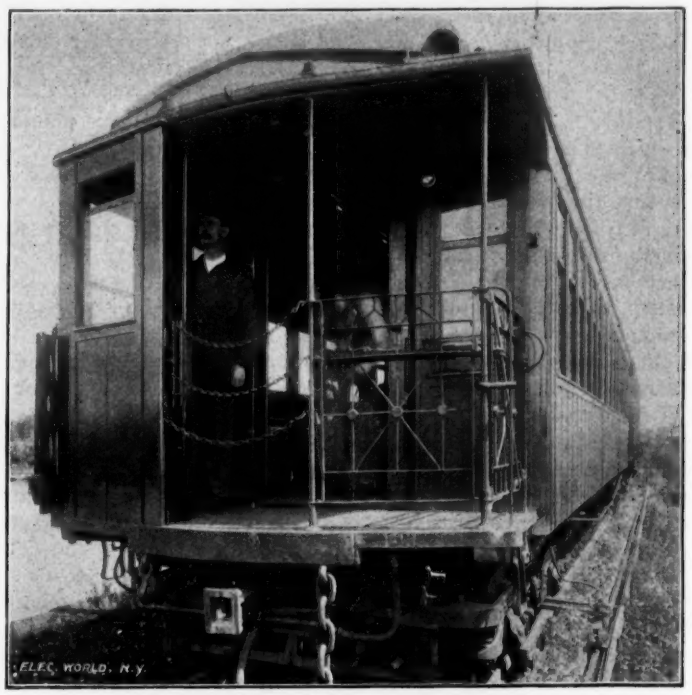
A PLATFORM SHOWING CONTROL AND AIR-BRAKE HANDLES.

erating apparatus, which was placed in the centre of the car adjacent to the instruments.

Complete unison and synchronous action of the motors on the various cars connected together in a train has been carefully provided for. The operation of the handle will produce an almost absolutely synchronous movement of the controllers in all the cars. Should, for instance, any one get out of unison, the others will be automatically controlled so that a new step cannot be made until the last has been fully reached by all.

Other devices also provide against the overloading of any one unit, which, under such conditions, will be protected from injury until the load has been distributed over the other units as well. Should any of the driving motors become disabled they are automatically cut out, that particular car being thus pulled along by the others. Such control of a number of cars composing a train, therefore, makes each absolutely independent. Each car starts and accelerates itself, and a careful examination of the draw-bars between the cars shows that this is borne out in practice, as no strains are shown on the connecting couplings when the train is in motion.

Each car of this train is equipped with automatic air-brakes of the Westinghouse type. These are controlled by engineer's valves on each platform, located adjacent to the operating switch. The



THE MOTORMAN'S CAB.

air supply for each car is provided by a standard automatic electric air pump and accumulator. The operation of this pump motor is by a pressure-controlling starting switch. Flexible pipe connections from car to car inter-connect the brake-controlling apparatus on each, and enable the train operator to brake all cars from any platform valve. Other braking methods will probably be developed whereby the control of the motors and brakes are more closely combined.

One of the cars has been equipped with a novel form of vestibule devised by Mr. Sprague. It is constructed so that it can be applied to any ordinary car platform, inclosing one-half of it and protecting the motorman and operating appliances.

In this enclosure he is within easy and undisturbed reach of the necessary controlling appliances and has an unobstructed view forward or back along the side of the train. The notable feature of this vestibule is the ease with which it can be opened at each side, leaving the platform free and clear whenever this particular controlling point is no longer occupied by the operator. Single lights are arranged in front of each car, and so connected that two inside lights can be switched out and the two signal lights substituted. The inside lights are arranged in three rows.

A short consideration of the various possibilities of this new multiple electric-railway system will clearly show that many highly desirable and important results, impossible with any other methods, can be accomplished. For suburban, elevated and other service, where maximum acceleration, variable speeds, and frequent trains are prime considerations, the solution of many important problems will unquestionably result. In such service, where the stations are quite frequent, the train operation largely becomes a mat-

ter of acceleration. In fact, the motor capacity is largely gauged thereby. It is highly desirable that the shortest possible time should be consumed in bringing the train to its maximum, having attained which and gotten under way, it is to run for some distance and then allowed to proceed by its own momentum, or "coast," in finishing the run. The highly increased tractive effect due to the distribution of the propelling agency over every car, each being thereby accelerated independently, although yet in complete unison with the rest, results in the attainment of an almost ideal condition.

It would be practically impossible to accomplish similar results with a single motor-unit train. Nearly 60 per cent. of the weight of a loaded multiple-unit train is available for traction purposes. The following is a comparison of weights in this train system:

Single empty car weighs, at motor end.....	23,670 pounds.
Free end	15,250 "
Total	38,920 pounds.

Supposing each car to carry 100 passengers at 135 pounds each, or a total of 13,500 pounds, one-half of which comes on the driving wheels, the weights then would be as follows:

Full car, motor end.....	30,420 pounds.
Free end	22,000 "
Total	52,420 pounds.

of which 58 per cent. is on the drivers.

If there are six cars in a unit, that is, making a train the same as a locomotive and five cars on the Manhattan Elevated, the total weight of loaded train will be 314,520 pounds, of which 182,520 pounds will be on the drivers. This is over five times as much as is on the drivers of the Manhattan Elevated locomotive, and perhaps more, or at least as much as on any steam locomotive in existence.

The acceleration current consumption will therefore probably not exceed that of the present slow acceleration methods ,but even if it should equal or exceed the present limits the collateral advantages due to the highly increased acceleration and more efficient running would become a primary consideration. The increased traffic capacity of the road due thereto will more than compensate for any other negative result. For equal acceleration the results certainly favor the multiple-unit plan.

The flexibility of operation of a road so equipped is almost limitless. Trains or single units may be operated at the closest headway, decreasing the waits at the stations to a minimum. The importance of this result, where the average passenger travels but short distances and in which the waiting time is a fair percentage of the total time spent, is very great. As the demands of the traffic vary the trains can be made larger or smaller without affecting the schedule. Any part of the trains, including one or more units, can be switched off on to branch lines and each maintain its own individuality. At the yards the handling of the cars is vastly simplified. The sub-division of the motor over each car unit will also have a more favorable effect upon the roadbed than a single unit train method. Altogether, many ideal conditions are attained in making each car unit a propelling unit. It may also be noted that Mr. Sprague intends to apply the system to street-car service, as well as heavier work. Electric motor cars with trailers have long labored under obvious disadvantages, as compared to the operation of cable cars under similar conditions, which the multiple-unit system removes.

Regarding the equipment necessary for each car it may be said that this is even less than would be essential in the case of an ordinary motor car with double controllers. The equipment of the present cars, whether already electrically equipped or not, will not necessitate any material changes.

From Monday, July 26, to Saturday, July 31, the train was put through various tests and trials over the test tracks at Schenectady. The ease and facility with which the train can be handled was demonstrated when Mr. Sprague's little son started and controlled the train on its first public run. All conditions were experimented with. Motors were cut out while the train was in operation, cars were uncoupled or added to the train while running and then controlled with the other unit; the train was made up of from one to six units and controlled from every platform, and even from cars whose motors were cut out and which acted as trailers. The coupling of additional cars to a train running at 25 miles per hour opens up great possibilities in railroading. This was successfully accomplished. These and many other tests were made, during which records of the performance of one unit of the train were taken. For this test the first car was fitted with an amperemeter in each motor circuit and in the main circuit of the car, also with a voltmeter and with lever and push-button-controlling switches, the latter being at the end of a flexible cable so that the car can be run from the inside, and the current reversed simultaneously. There was also a special Boyer recorder and visible indicator, with a Tandy chronograph attachment, so that complete records of acceleration, change of current, coasting, braking time, etc., were gotten. Tests were made first with a single car reading, then with a second, a third, and so on added. So long as the readings in the first cars are practically unchanged for each increment of car, each must be doing its respective duty.

The machines are now geared to give an acceleration of about 1 mile second rate up to 20 or 25 miles, with a maximum speed of about 38 miles at about 540 volts. The schedule speed is guaranteed at 15 miles, with existing station intervals of 2150 feet, and with station stops not exceeding ten seconds, at 500 volts. The road will be operated at 600 volts.

On a test made, an 18-mile schedule was secured, with a maximum of 32 miles speed. The machines will eventually be geared to at least 1½ mile or possibly 2-mile second acceleration for the first part, and will make a schedule speed of about 16 or 17 miles.

In a comparative test of one car and a train of five cars, the former made 38 and the latter 37 miles, and each had the same acceleration. When run at about 37 to 38 miles the current used is from 29 to 30 amperes at steady speed. The motors themselves are tested to 95 amperes each for one hour, with an increase to 200 amperes each at the end of the run for ten minutes, a most exacting test. With change of regulator the machines can easily make 50 to 60 miles an hour. The whole question of gearing ratio, motor capacity, etc., is a function in part of the required schedule speed and the distance between stations, becoming of vital importance with high speeds and frequent stops.

On Monday, July 26, Mr. Sprague sent the following telegram to Miss Sarah J. Farmer, at Greenacre, Me:

"I regret exceedingly that recent absence abroad and urgent business engagements since my return have prevented the preparation of my intended paper on electric railways, and to my great disappointment I am also denied the privilege of attending the meeting of the Institute of Electrical Engineers at the noble memorial you have established to the memory of your distinguished father.

"I am, however, with you in spirit, and, furthermore, by a coincidence which I hope may prove an auspicious augury, this day, the fiftieth anniversary of the first exhibition at Dover by Moses G. Farmer of the movement of a car by electricity, has seen the inauguration and first public demonstration of an electric train, properly speaking, that is, one in which each car is individually equipped with motors and all are electrically controlled from any desired point, a new departure in electric propulsion as distinguished from locomotive practice, the logical sequence of the adoption of electricity for railway work, a train of six cars having been successfully operated by a boy of nine years.

"The advancement of the electric railway in the decade since the installation of the Richmond railway is unparalleled, and no advance in the industrial world has had a more widespread and beneficial effect on the social and moral well being of the community. In 1887 there were scarcely a dozen electric railways in existence; today there are 700 in the United States alone. Then there were scarcely 100 miles of track, now there are nearly 14,000 miles. From 150 cars, the equipment has grown to over 35,000, propelled by 52,000 motors.

"Prediction would perhaps be idle, but it would seem that we are entering on a new era of railway progress whose extent cannot well be limited, in which not only city but suburban, and in a large measure interurban, passenger traffic will be electric in all its essetials. Frank J. Sprague."

Telephone to the Klondike Gold Fields.

Articles of incorporation of the Alaska Telegraph & Telephone Company were filed this week by San Francisco capitalists. The plan is to run a telegraph line from Juneau to Dawson City over the trail by way of Chilcoot Pass. A cable containing both telegraph and telephone lines will be laid, which will rest on the surface of the ground, no poles being used. Stations are to be established every 50 miles.

Electricity as a Motive Power on Elevated Railways.

BY S. H. SHORT.

The elevated railways of New York, Brooklyn and Chicago were built to satisfy a crying demand for rapid transit from the business centres to the suburban districts of these great cities. So long as they had for their only competitor the slow-moving horse-car they were considered a great convenience, notwithstanding that one was obliged to walk from one to three blocks and climb a difficult flight of stairs to reach these rapidly moving trains.

Since the "trolley car" has come into general use, people have been educated to a still more rapid rate of travel, and where the trolley car parallels the elevated railroad, as in Brooklyn and Chicago, the frequent, speedy and accessible surface car is, by far, the more popular. In New York, however, the elevated railways still enjoy a very large traffic, because the electric cars do not parallel their lines, nor are the facilities for transportation yet sufficient for the enormous masses to be moved back and forth in that city. However, the surface lines are soon to be equipped electrically, and their carrying capacity thereby enormously increased, to the detriment of the elevated-railway travel. In order to retain their traffic, it will be necessary for the elevated railways to move their trains more frequently, and at a much greater rate of speed, to compensate the traveling public for being obliged to walk some distance and climb those disagreeable stairs.

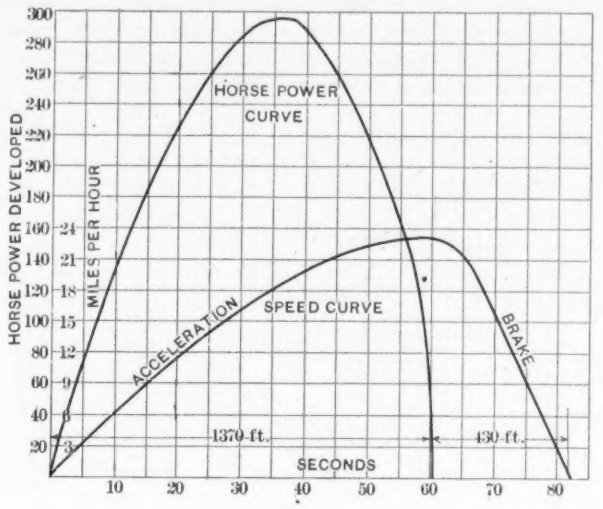


FIG. 1.

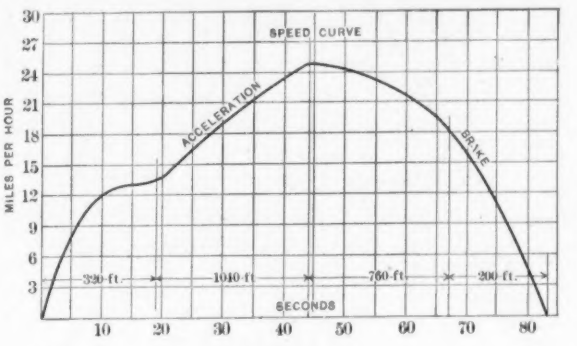


FIG. 2.

It would add greatly to the travel on these roads were some plan devised for mechanically lifting passengers to the elevated stations.

The elevated roads are all built on the same general plan, the structure being provided with double track throughout the entire length, with stations about one-third of a mile apart. The grades are slight, and the curves of not less than 90 feet radius. The structure is made to safely carry the standard elevated train, *i. e.*, five passenger coaches, each 48 feet in length, weighing, when loaded with seventy-five passengers, 20 tons, drawn by a locomotive weighing 23½ tons, making a total of 123½ tons for the complete train.

The locomotives are constructed so that 65 per cent. of their weight, or 15¼ tons, are upon their drivers, giving an adhesion, and therefore a maximum horizontal effort for accelerating the train, of 7650 pounds. This effort is utilized for accelerating the train for fifty or sixty seconds, and a speed of 20 to 25 miles per hour is attained, while a maximum of 300 horse-power is developed by the locomotive. The brakes are then applied with a negative acceleration, and the train is brought to a standstill at the next station, where it remains on an average of thirteen seconds.

In the accompanying diagrams (Figs. 1 and 2) I have illustrated graphically the performance of one of these trains between stations, also the consumption of power, as calculated from the weight and speed of the train. It will be seen, therefrom, that it is not possible with steam to make a better schedule time than is at present in force, *i. e.*, 13½ miles per hour, unless the weight of the locomotive be increased or the trains be lightened. The heavier locomotives would endanger the safety of the entire structure. The lighter loads would necessitate more frequent trains, consequently a much larger force of skilled employees to run the extra locomotives. The cost of fuel for operating a steam locomotive amounts to about 20 per cent. of the total operating expenses of these roads, the fuel consumption being about 7 pounds to 8 pounds of coal per horse-power per hour.

With good compound condensing engines, driving electric generators at a station, the coal consumption is reduced to about one-third of that amount.

Were steam locomotives discarded, it would be possible to replace the high-priced skilled labor, necessary for their operation, by ordinary trustworthy men, who are not skilled mechanics, whose rate of wages is about one-half that of a locomotive engineer, and only one man would be necessary to operate the electrical propelling mechanism. We believe the repair account will be materially lessened, both in the units of motive power and in the permanent way, were the trains equipped with motors. The care of a steam locomotive is very onerous, the average run being only about 100 miles, when it must be thoroughly overhauled and inspected by skilled mechanics before being used again. Contrast with this the all-day service of most electric motors, 200 or 300 miles a day for days and weeks, without inspection, cleaning or care of any kind.

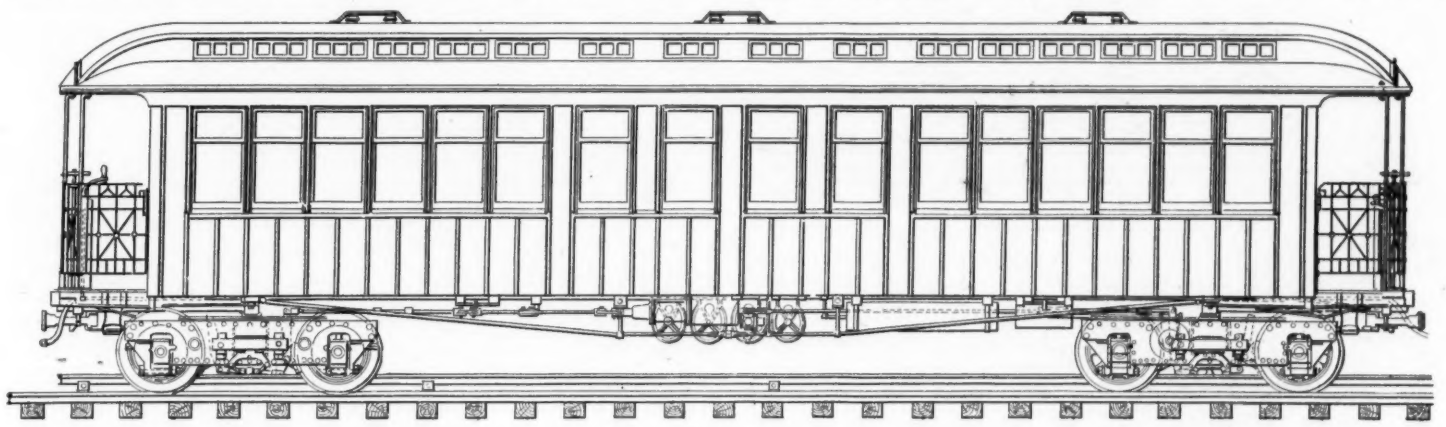


FIG. 3.

The standard electrical equipment for an elevated train consists of the present elevated car, as illustrated in the accompanying engraving (Fig. 3), provided with two swiveled trucks of special con-

struction, arranged to receive electric motors of a type adapted especially for this service. The wheels of the trucks are 33 inches in diameter, and the wheel base does not exceed 6 feet for the largest motors, and is reduced to 5 feet 6 inches where motors of the smaller size are used. The weight of the motor car, loaded to its full capacity with passengers, is 32 tons, including trucks, motors and the electrical equipment. In most cases it is advisable to use

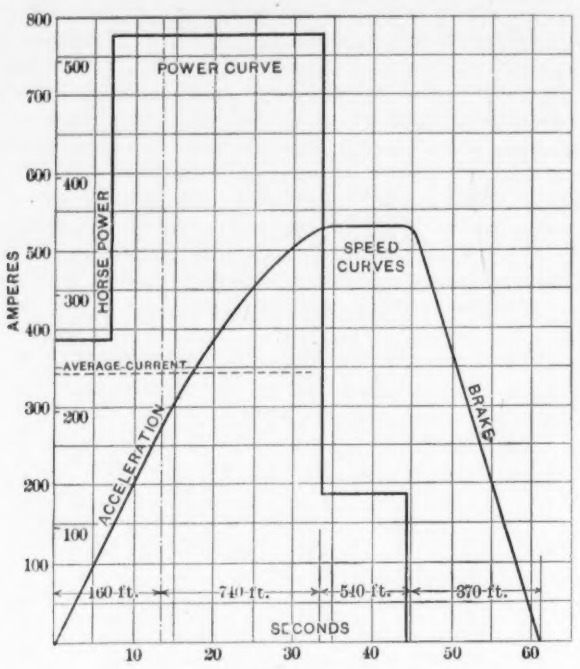


Fig. 4.

only two motors upon a motor car, and both should be placed on one truck for convenience in repairing. There is, therefore, 19½ tons upon the drivers, or 61 per cent. of the total weight of the motor car, which corresponds favorably with the percentage of the total weight of passenger locomotives upon their drivers. This gives an adhesion, and therefore a maximum practical horizontal effort for the motor, of 9750 pounds, or, a total possible horsepower of 400, in accordance with standard motor rating.

This pair of motors is, therefore, capable of accelerating a train

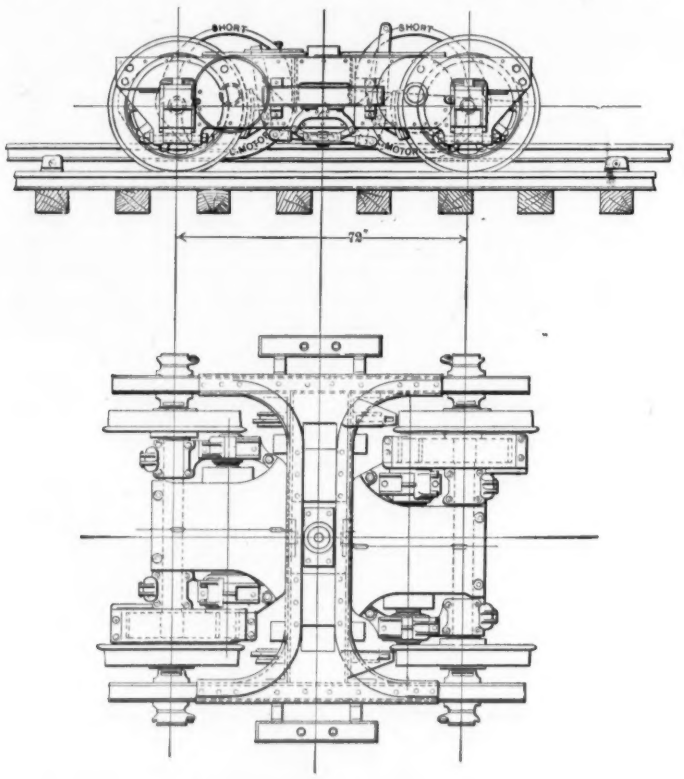


Fig. 5.

of three standard elevated cars, at the rate of 1.85 feet per second, and of making a schedule of 16½ miles per hour, including stops, as illustrated graphically by the acompanying diagram (Fig. 4).

If the other truck of the motor car is also equipped with motors, a train of double this size will operate in exactly the same manner, and one more car may even be added, because the tractive effort required per ton decreases materially as the number of the cars in the train increases, there being but one motor car on the train. It is not advisable to use more than two motors, owing to the complications which arise in the controlling devices.

The requirements of the service to be rendered on the different elevated railways necessitate very careful consideration being given to the size of the motor to be used upon the different roads. There seems to be no question about the advisability of using as large a motor as possible upon a road like the Sixth Avenue, in New York, where the travel is constant throughout the day, and trains of from four to five cars can follow each other at short intervals all day. But in Brooklyn and Chicago, where the traffic is heavy during short periods of time, and light during a larger part of the day, it seems desirable that trains of few cars, or even single motor cars, shall be run at frequent intervals without a printed time table,

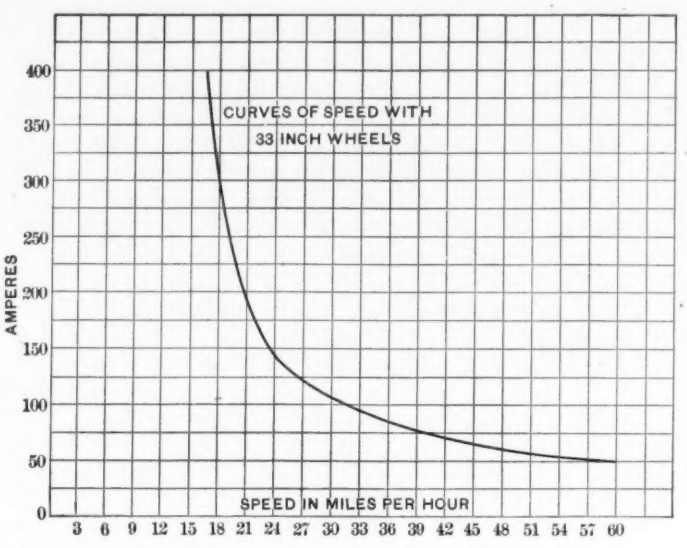


Fig. 6.

thereby practically securing a high-speed street-car service on the elevated structure.

Another reason for frequent and light trains is that these roads have branches which by this method would be served to better advantage. It is possible, also, that these single-motor cars or

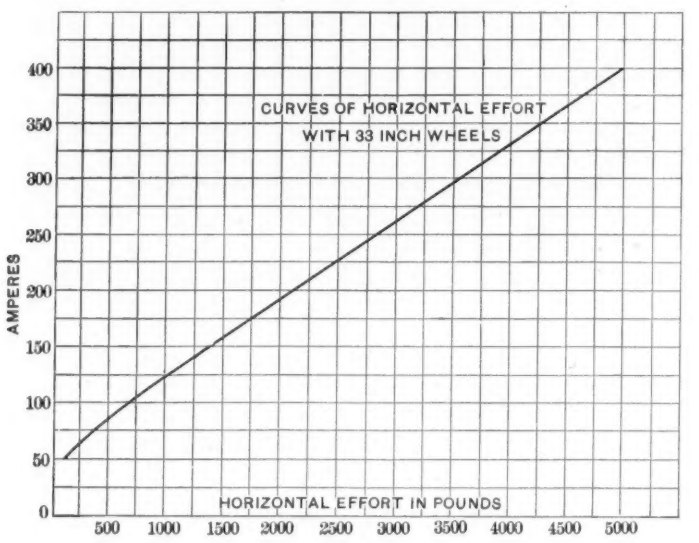


Fig. 7.

short trains may be coupled into longer trains during the rush periods of the day, and be operated from the front platform by one motorman, if a suitable controlling apparatus is provided, by means of which all of the motors of the train can be simultaneously controlled.

A motor of much smaller size than would take up the full ad-

hesive power of the truck could be used, where this method of equipment is adopted. It has, however, the disadvantage of multiplying the electrical apparatus necessary to move the rolling stock of the road. It will also consume more power per ton miles of train, because the tractive effort per ton of the trail cars is about half that required by the motor cars, the difference being due to the friction, windage, etc., of the motor cars.

The accompanying diagram (Fig. 5) illustrates the Baldwin standard elevated truck equipped with two standard 200-hp L motors, which we have recently designed for this work. These will operate a standard elevated train of three cars, fully loaded, at a schedule speed of 16½ miles per hour. We give also the train data sheet for this equipment, and speed and horizontal effort curves for the motors. (Figs. 6 and 7.)

TRAIN NO. 1.

Elevated Railway Service.

No. of cars in train	3	
Full speed of train on level track (miles per hour)	31	
Average speed, stops 1-3 mile apart " " "	16.5	

MOTOR CAR.

Weight of motor car body	10	Tons.
Weight of both trucks	10	"
Weight of two motors	7	"
Weight of seventy-five passengers	5	"
Total weight of loaded motor car	32	"
Number of motors on motor car	2	
*Commercial rated power of each	200	H. P.
Safe constant load for each	100	"
Safe temporary tractive effort of equipment	10,000	Lbs.
Safe constant tractive effort of equipment	3,500	"
Weight on drivers	19.5	Tons.
Ratio of weight on drivers to total weight	26%	
Adhesive power	9,750	Lbs.
Ratio of safe temporary tractive effort to adhesion	100%	
Ratio of safe constant tractive effort to adhesion	36%	

COMPLETE TRAIN.

Total weight of loaded motor car	32	Tons.
Weight of two coaches	32	"
Weight of 150 passengers in coaches	10	"
Total weight of loaded train	74	"
Maximum horizontal effort in accelerating train	9,750	Lbs.
Horizontal effort per ton during acceleration	132	"
Maximum power in accelerating uniformly to full speed	412	H. P.
Maximum current at 500 volts accelerating train uniformly to full speed	780	Amp.
Time required in accelerating uniformly to full speed	34	Sec.
Distance at which train will acquire full speed	900	Ft.
Horizontal effort, train running uniform speed	1,300	Lbs.
Power consumed, train running uniform speed	106	H. P.
Tractive effort per ton	18.25	Lbs.
Maximum practical negative horizontal effort in braking	13,800	Lbs.
Time required to bring train to full stop	16	Sec.
Distance traversed by train during braking	370	Ft.

TRAIN PERFORMANCE.

Track.	Horse Power.	Current at 500 Volts.	Speed, miles per hour.	Horizontal Effort.
Level	106	190 amperes.	32	1,300 lbs.
1 per cent. grade	170	290 "	22	2,780 "
2 " "	235	400 "	20.8	4,260 "
3 " "	295	505 "	19	5,740 "

The next diagram (Fig. 8) shows a standard Jackson & Sharp truck, equipped with two 125-hp L motors, of the same design, capable of moving a standard elevated train of two cars fully loaded, at a schedule speed of 16 miles per hour. Figs. 9, 10 and 11 give a train data sheet (train No. 2) and curves for this equipment.

* This motor will deliver the commercial rated output for one hour without heating more than 75° C above the surrounding air.

TRAIN NO. 2.

Character of Service; Elevated Railway.

Number of cars in train	2	
Full speed of train on level track (miles per hour)	31	
Average speeds, stops 1-3 mile apart	15.8	

MOTOR CAR.

Weight of motor-car body	10	Tons.
Weight of both trucks	10	"
Weight of two motors	5.5	"
Weight of 75 passengers	5	"
Total weight of loaded motor car	30.5	"
Number of motors on motor car	2	
*Commercial rated power of each	125	H. P.
Safe constant load for each	60	
Safe temporary tractive effort of equipment	5,600	Lbs.
Safe constant tractive effort of equipment	1,600	"
Weight on drivers	18	Tons.
Ratio of weight on drivers to total weight	35%	
Adhesive power	9,000	Lbs.
Ratio safe temporary tractive effort to adhesion	62%	
Ratio safe constant tractive effort to adhesion	18%	

COMPLETE TRAIN.

Total weight of loaded motor car	30.5	Tons.
Weight of one coach	16	"
Weight of 75 passengers in coach	5	"
	51.5	"
Maximum horizontal effort in accelerating train	5,640	Lbs.
Horizontal effort per ton during acceleration	109	"
Max. power in accelerating uniformly to full speed.	280	H. P.
Max. current at 500-v. accelerating uniformly to full speed	500	Amp.
Time required in accelerating uniformly to full speed	37.5	Sec.
Distance in which train will acquire full speed	953	Ft.
Horizontal effort, train running uniform speed	1,000	Lbs.
Power consumed, train running uniform speed	115	H. P.
Tractive effort per ton, train running uniform speed	19.7	Lbs.
Max. practical negative horizontal effort in braking	11,000	Lbs.
Time required to bring train to full stop	16	Sec.
Distance traversed by train during braking	390	Ft.

TRAIN PERFORMANCE.

Track.	Horse Power.	at 500 volts. Current	Speed, miles per hour.	Horizontal Effort.
Level	92	175 amperes.	31	1,013 lbs.
1 per cent. grade	135	250 "	24.8	2,043 "
2 " "	176	320 "	21.3	3,073 "
3 " "	220	390 "	19.9	4,103 "

The next diagram (Fig. 12) shows two 60-hp motors of the L type, mounted upon a standard McGuire truck, capable of operating a single standard elevated coach at a schedule speed of 15½ miles per hour, with its corresponding train data sheet (Train No. 3) and curves (Figs. 13, 14 and 15).

TRAIN NO. 3.

Elevated Railway Service.

Number of cars in train	1	
Full speed of train on level track (miles per hour)	26	
Average speed, stops one-third mile apart (miles per hour)	15	

MOTOR CAR.

Weight of motor car body	10	Tons.
Weight of both trucks	10	"
Weight of two motors	3.5	"
Weight of seventy-five passengers	5	"
Total weight of loaded motor car	28.5	"
Number of motors on motor car	2	
*Commercial rated power of each	60	H. P.
Safe constant load for each	25	"
Safe temporary tractive effort of equipment	3,300	Lbs.

*This motor will deliver a commercial-rated output for one hour without heating more than 75° C. above the surrounding air.

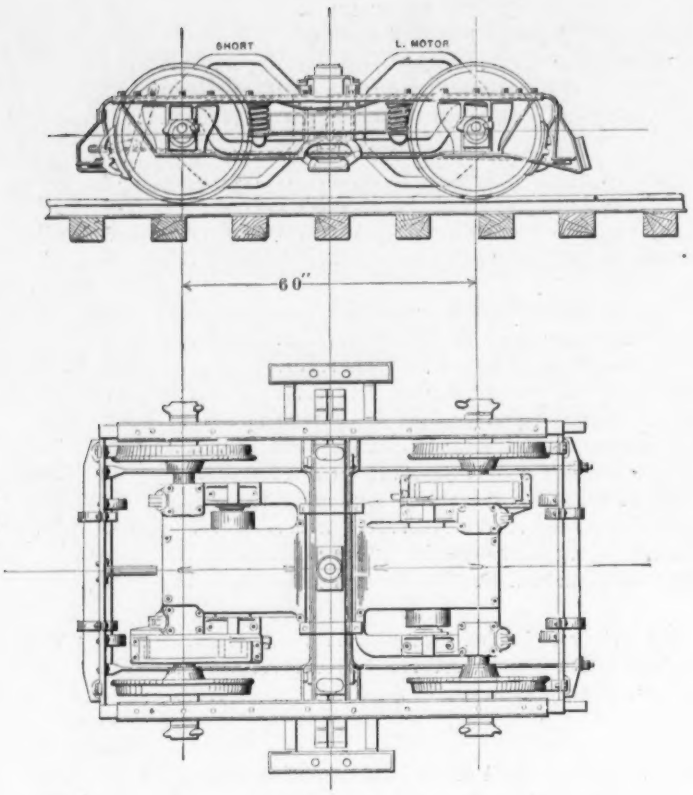


Fig. 8.

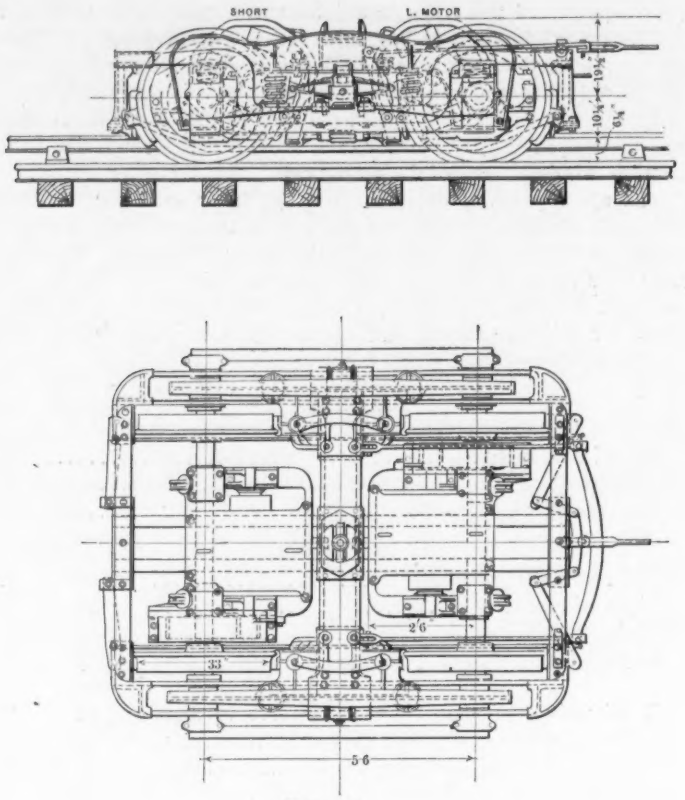


Fig. 12.

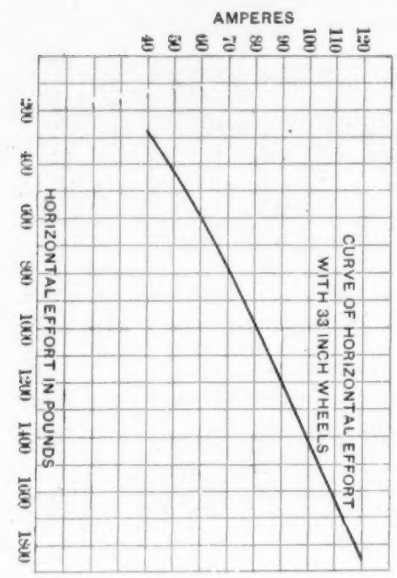


Fig. 15.

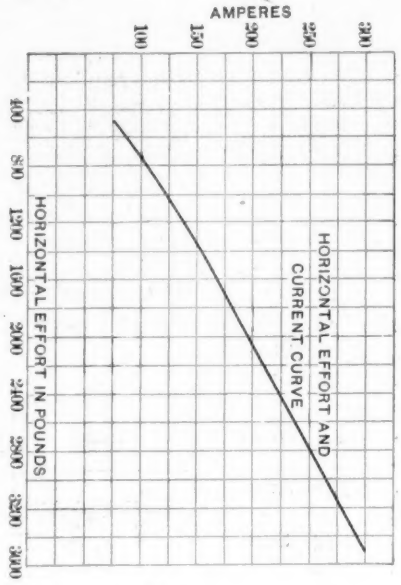


Fig. 10

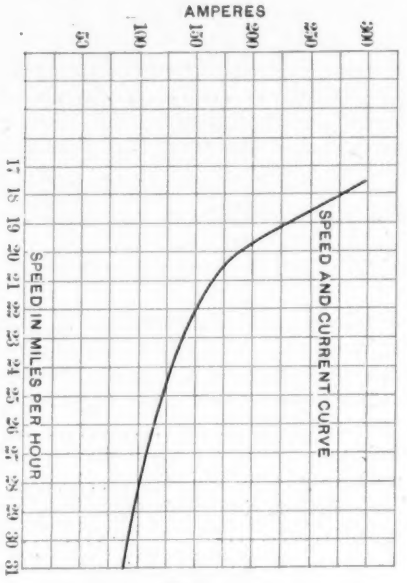


Fig. 9.

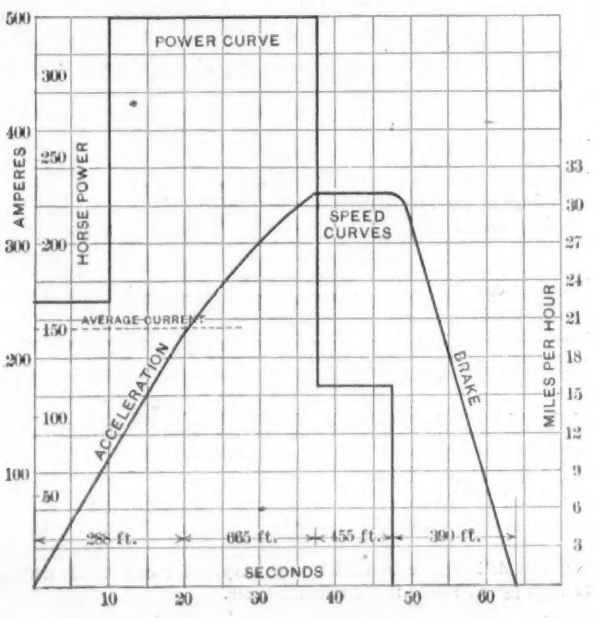


Fig. 11.

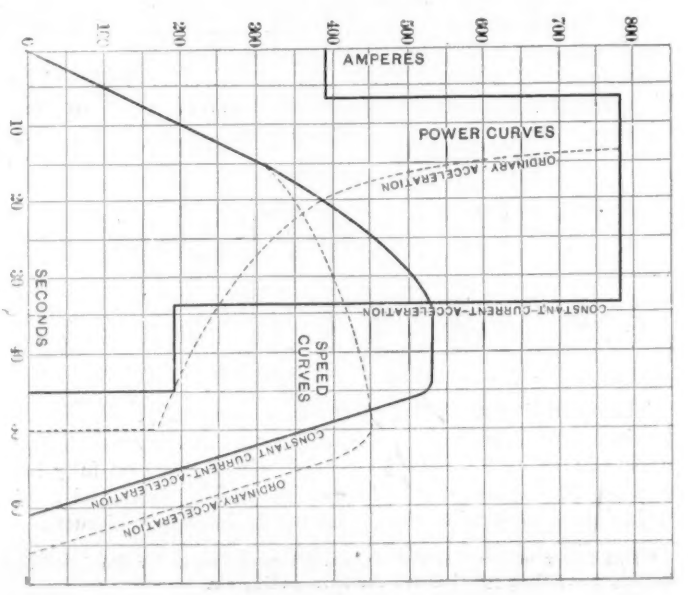
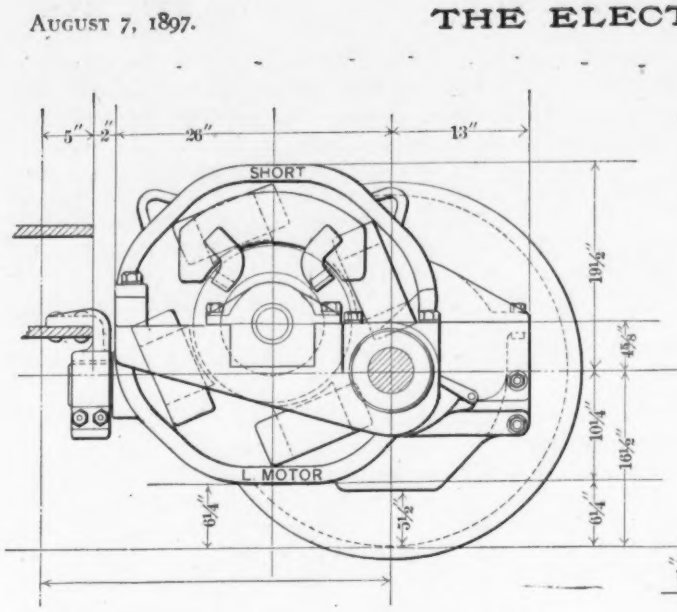


Fig. 18.



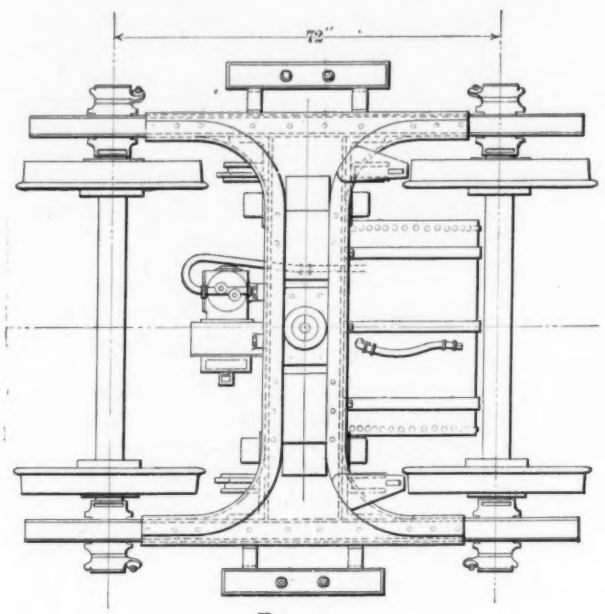


FIG. 19.

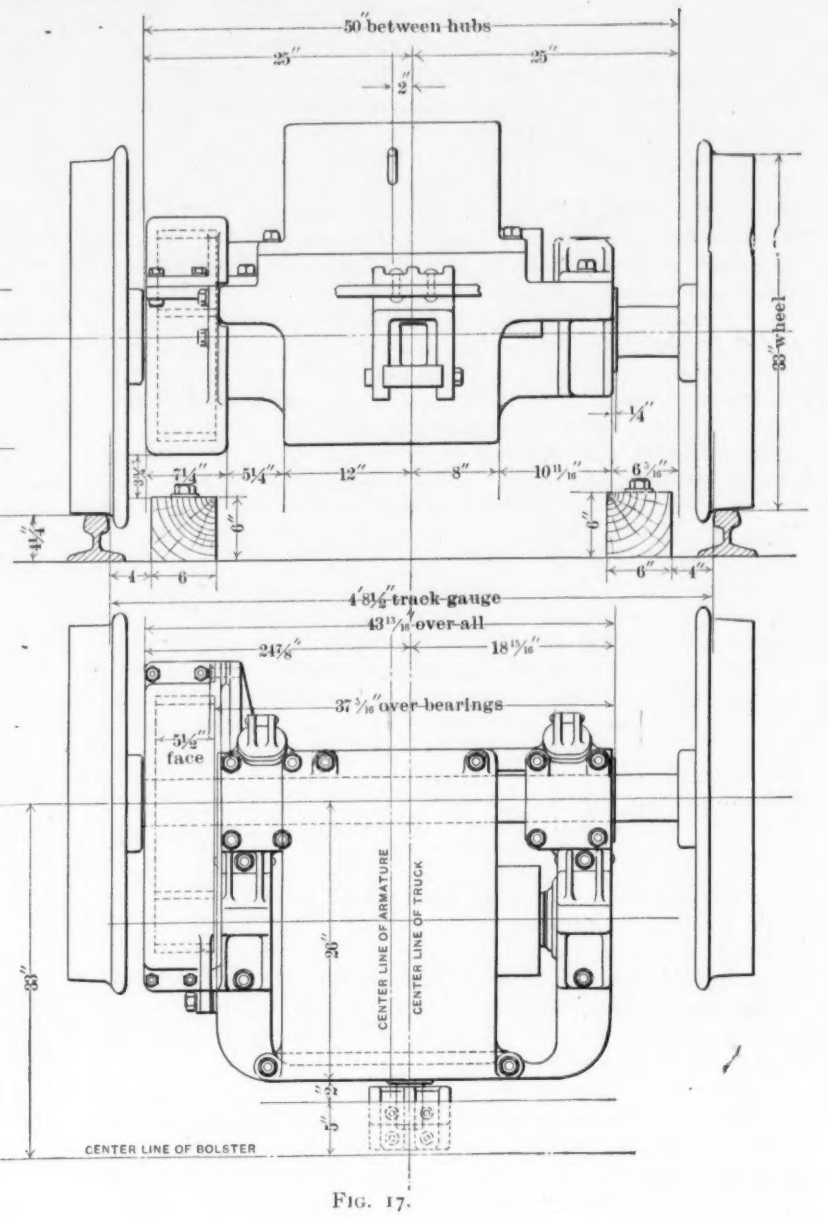


FIG. 17.

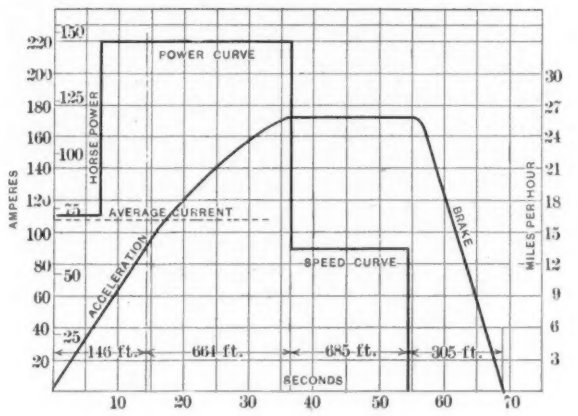


FIG. 13.

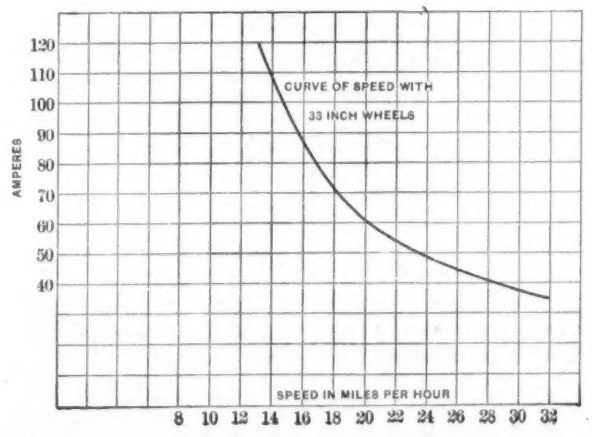


FIG. 14.

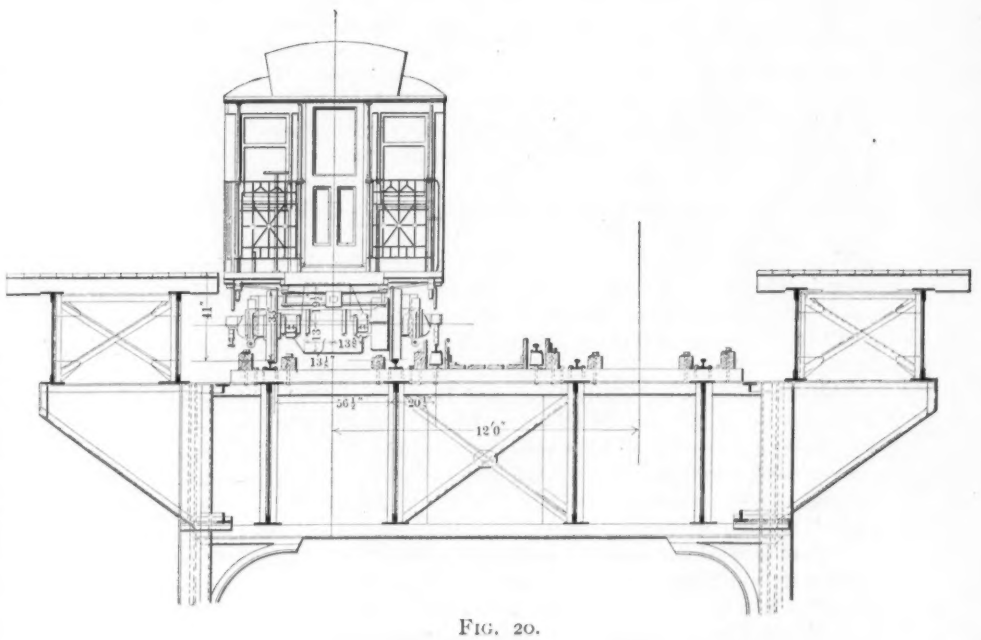


FIG. 20.

Safe constant tractive effort of equipment	700 Lbs.
Weight on drivers	16 Tons.
Ratio of weight on drivers to total weight	56%
Adhesive power	8,000 Lbs.
Ratio safe temporary tractive effort to adhesion	41%
Ratio safe constant tractive effort to adhesion	8%

COMPLETE TRAIN.

Total weight of loaded train	28.5 Tons.
Maximum horizontal effort in accelerating train	2,600 Lbs.
Horizontal effort per ton during acceleration	91.5 "
Max. power in accelerating uniformly to full speed	122 H. P.
Max. current at 550-v. accelerating uniformly to full speed	220 Amp.
Time required in accelerating uniformly to full speed	36.5 Sec.
Distance in which train will acquire full speed	810 Ft.
Horizontal effort, train running uniform speed	712 Lbs.
Power consumed, train running uniform speed	51 H. P.
Tractive effort per ton, train running uniform speed	25 Lbs.
Max. practical negative horizontal effort in braking	5,300 Lbs.
Time required to bring train to full stop	14.5 Sec.
Distance traversed by train during braking	305 Ft.

TRAIN PERFORMANCE.

Track.	Horse Power.	Current at 500 Volts.	Speed, Miles per hour.	Horizontal Effort.
Level	51	90 amperes.	26	712 lbs.
1 per cent. grade	68	124 "	19.9	1,282 "
2 " "	85	154 "	17.2	1,832 "
3 " "	101	182 "	15.5	2,422 "

For the convenience of engineers making calculations for the required current in amperes at 500 volts pressure, which will be necessary to operate a given line of road with trains as specified above, the table herewith (Fig. 16) is given, showing the maximum current consumed by trains during acceleration; the current necessary to operate the trains at full speed; and the average current and horse-power for the various trains.

MOTOR BEST SUITED TO ELEVATOR SERVICE.

As there is neither dust nor water to contend with, the motor can be left entirely open, for the free circulation of air over the armature and field magnets, and not only thorough ventilation, but 20 per cent. more output, can be obtained from a given machine in this way. The open motor can be much more easily inspected and kept free from oil and grease.

The accompanying diagram (Fig. 17) shows the form of motor which we have designed for elevated-railway service. This motor is intended to be taken apart by running the truck from under the car, and lifting the upper half of the magnetic ring by means of an overhead crane; this exposes the armature, left with its bearings in the motor frame, which is journaled to the car axle at one side and supported by the truck bolster at the other side. The motor frame has cast, integral with it, the lower half of the magnetic ring. Each half of the magnetic ring has two pole pieces, wound with a few turns of heavy copper ribbon, so that the magnetic system of the motor is symmetrical, and of very large sectional area, to provide for the rapid acceleration control, which will be discussed later.

The magnetic ring is large in diameter and the axle is made to pass inside the ring, between the magnet coils, so that the distance between the gear centres is short. This makes the gears small in diameter, and gives a large clearance above the stringers inside the rails.

The armature is especially large and heavy, provided with deep slots to secure the bar winding, which makes but one turn per commutator bar. By this means the self-induction of the armature windings is reduced to a minimum, and there is a very low voltage between the commutator bars, providing for perfectly sparkless commutation.

Bronze is used for both the armature and axle bearings, and the lubricant is oil instead of grease. The brasses are so arranged that the thrust caused by the gears brings the shafts against solid unbroken surfaces. The oil is stored in cellars and is carried to the bearings by means of waste, which wipes the entire length of the shaft within the brasses.

Provision is made at the ends of the bearings to collect all of the oil which may escape, and return it to the cellars to prevent a drip on the structure and street beneath. The bearings are made exceedingly long and the shafts are large in diameter, the pressure per square inch being reduced to the very low value of 37 pounds. The armature bearings are solid, and are lifted out of the motor together with their oil cellars when the armature is removed by an overhead crane. The gear housing is made of heavy cast iron in halves, the lower half being permanently fastened to the motor frame, while the upper half may be lifted off independently by the overhead crane. The housing is grease tight, and the gears run in oil. The entire motor is cast from the best quality of steel.

THE CONTROL.

The motors are controlled by a series-parallel controller, which provides for keeping a constant current through each of the motors, of such a quantity as will just avoid slipping the wheels during the time of acceleration. We have named this the maximum-constant current acceleration controller. In order to accomplish this kind of a control, the counter E. M. F. of the motors is prevented from rising until the train has reached the maximum speed at which it is desired to operate it. The counter E. M. F. is then instantly raised to a point which reduces the current to a quantity which produces a horizontal effort sufficient to overcome the resistance of the train and maintain a constant speed.

The accompanying diagram (Fig. 18) shows the acceleration curve of an ordinary series-parallel controller and two series motors; also a curve of the constant-current method of control, with two motors of the same size. The advantages of this latter method are apparent in the decrease of the schedule time and the decrease of power consumption.

THE BRAKES.

Westinghouse automatic air brakes are used on all trains, with a brake applied to every wheel, enabling a train to be brought to a stop with a negative acceleration of 3 feet per second, which is not disagreeable to passengers.

The train pipe for this system of brakes is fed with air from a main reservoir attached to one side of the truck bolster (Fig. 19) of the idle truck of the motor car, as illustrated in the engraving. On the other side of the truck bolster is attached an electric motor air compressor as illustrated. The motor is arranged to automatically stop and start under the influence of the varying pressure in the main reservoir. The object in putting the air-compressing apparatus on the truck instead of on the car body is to avoid the disagreeable noise due to the operation of the pump, and to facilitate repairs, as the truck with its entire air-compressing outfit is run out from under the car in the same manner as the motor truck.

THIRD RAIL FEEDER SYSTEM.

A third rail of varying section should be mounted throughout the entire length of the road on substantial insulators. Heavy rails should be laid near the station and gradually taper off to the ends of the road. For most "L" roads it is not necessary to use auxiliary feeders of any kind, as the entire power necessary to operate all trains can be carried by the third rail. This rail should be placed on one side of the track with its head some inches above the track rails, so that sliding shoes, made of cast iron and attached to the trucks, may slide freely along their upper surface (Fig. 20).

The table (Fig. 21) on the inset shows the amount of power which rails of different section can carry, with a drop of 100 volts per mile, when all the power is delivered at the end of the mile. Of course, the same amount of power can be distributed with the same drop over 2 miles of track. The table also shows the relative cost of this method of distribution as compared with copper feeders.

BONDING.

All rails, as far as practicable, should be in 60 foot lengths. The third rail as well as the track rail joints should be bonded by the flexible copper bond, attached to the under side of the foot of the rail by means of a number of rivets, and the area of contact with the rail should be sufficient to provide that not more than 100 amperes per square inch should be required to pass through the joint between the steel and copper. The sectional area of the bond must be one-sixth the sectional area of the rail itself. The track rails should be electrically connected frequently with the elevated structure. Care should be taken that all joints between copper and steel should be made with clear, bright surfaces, and no space be left to admit water or air to corrode the joints.

Electric Elevator Problems and Some of Their Solutions.

BY J. E. WOODBRIDGE.

The electric elevator is steadily winning its way in competition with its most formidable rival, the hydraulic elevator, until now it is coming to be recognized as a success in the very stronghold of the latter, namely, the long-run high-speed passenger service.

The electric machine obtained its first foothold in installations so small that the expense of running a steam pump with an engineer in attendance to supply hydraulic machines was prohibitory. Where electric power was available it was used sometimes to pump water for hydraulic machines, but often to work direct electric elevator machines.

Gradually the weak points of the latter were remedied, and their economy became apparent, until now they are installed in direct competition with hydraulic apparatus in buildings with complete power plants.

There are three good reasons for the increased economy of power of the electric elevator over that of the hydraulic.

The demand for power of an elevator is so variable that the steam pump supplying it must be capable of working over a wide range of speeds and of starting and stopping promptly. This requires the use of direct plunger duplex steam pumps, worked non-expansively, of which the steam consumption per effective horse-power is far greater than that of any steam dynamo.

The working cylinder of every hydraulic elevator is made large enough not only to lift the maximum rated load of the elevator, but a margin must be left to give this load a prompt acceleration. How wide this margin must be is shown by electric elevators, which require from two to six times as much current to start a load as to lift it, once it is under way. As the torque exerted by a shunt motor is approximately proportional to the current used, this shows that a large margin of power must be allowed in hydraulic cylinders to give acceleration. The hydraulic cylinder is no respecter of loads. It takes a full charge of water every time the elevator makes a trip, whether the car is empty or full of passengers, and it takes that water at sufficient pressure not only to lift the car full of passengers, but to accelerate that maximum load promptly. The surplus power, once the car is under way, is wasted in heating the water by throttling at the valves. The same is true of the additional surplus due to light loads. The electric elevator on the contrary, adjusts its power consumption to the work to be done.

So far as the writer knows, all hydraulic elevators are single acting, that is, the car either goes up or comes down by gravity. In case the car comes down by gravity the weight of the empty car must be greater than that of the counterweight by an amount sufficient to overcome all friction and give prompt acceleration to the system. When the car reaches full speed the force allowed for acceleration is balanced by throttling at the discharge valve. All energy given off by descending loads is disposed of in the same simple manner. This energy must be supplied by the hydraulic cylinder in the ascent. If the car ascends by gravity, the counterweight being heavier than a loaded car, the case is only made worse by the increased inertia of the system requiring a greater unbalanced force for its acceleration.

The electric elevator, however, may be and commonly is arranged to be double acting, the motor being shunt wound and arranged to work in either direction. If, with such a system, an unbalanced load descends, of sufficient magnitude to more than overcome the friction of the apparatus, the motor works as a dynamo and returns the surplus energy to the line. Another great advantage of the double-acting motor is the fact that it allows over-counterweighting, that is balancing by counterweights not only the car, but the average load. To illustrate by a numerical example: Consider the case of a car weighting 2000 pounds, designed for a load of 2000 pounds. If the motor is single acting, working only on the ascent of the car, the latter must be heavier than the counterweight by an amount sufficient to overcome all friction of the apparatus and to start it downward promptly. This limits the counterweight to about 1000 pounds. Then when the car ascends with full load the motor has to lift an unbalanced load of 3000 pounds, in which case the maximum unbalanced load to be lifted by the motor is 1000 pounds.

For buildings of moderate height not requiring a greater elevator speed than 300 feet per minute, the drum machine, with a worm wheel on the drum shaft, engaging with a worm on the armature shaft, has been found very satisfactory, and is the type almost universally used for such work. The machine is, as a rule, placed on the basement level. Obviously with a counterweight heavier than the car the two cannot be directly joined by the supporting cables or the car would not descend unless pulled down. Early practice was to run all the supporting cables of the car over the head sheaves and thence down to the machine drum, the counterweight cables being similarly run and wrapped on the drum, of course, in opposite direction. This arrangement required considerable cable and an inordinately long drum, and imposed double the weight of the car, load, and counterweight on the head sheaves. A better arrangement was soon devised by using, instead of one large counterweight, two smaller ones. One-half of the car-supporting cables ran directly from the head sheaves down to one of these counterweights. The other half of the cables ran *via* the head sheaves down to the machine, to which was connected also the second counterweight. This reduced the length of the drum 50 per cent., as only one-half as many cables ran on it. The weight on the head sheaves was also reduced by this change about 25 per cent. and the total amount of cable used about 35 per cent.

With the increasing height of buildings and increasing speed required for ascending them, one of the chief difficulties encountered is inertia. The cables become so long that their weight unbalances the system seriously adding as they do to the car weight when the car is down and to the counterweight when the car is up. To balance them it is necessary to attach tail cables or chains under either the car or counterweight or both. This adds still more to the mass to be set in motion. Stops are frequent, the intervals between them averaging only a few seconds in length. At every start, in high speed service, the full velocity must be attained with about as great an acceleration as is consistent with the comfort of the passengers, or the service will be too slow. This acceleration is perfectly uniform from the instant of starting until full speed is attained. Uniform acceleration means uniform torque, which, with electric motors, means uniform armature currents. An ordinary car in a high building, with load cables, counterweights, tail chains, and so forth, may weigh 10,000 pounds. Such a mass, moving at the rate of 600 feet per minute, for example, contains a kinetic energy in round numbers of 15,000 foot pounds. A fair value for maximum acceleration consistent with human effort is 4 feet per second, or one-eighth the acceleration of a free fall. If the elevator assumed above is accelerated up to speed at this rate by a shunt motor taking current through a rheostat from a constant potential source, the power consumption can be readily calculated. For acceleration alone the power consumed will be approximately 22 horse-power, divided by the efficiency of conversion between the motor brushes and the masses accelerated. This load of 25 or 30 horse-power will be exerted for two and one-half seconds every time the machine starts in either direction, in addition to the power required for actual lifting and the overcoming of friction. It is this oft-repeated abrupt demand for current which makes elevators so hard on dynamo regulation and engine governors, and often prohibits the running of elevators from lighting circuits.

One way of ameliorating this difficulty is, of course, by reducing the weight of the masses to be moved. Anything gained in lightness of construction of the car or of the cables is a double gain, as the counterweights or tail chains can be lightened to the same extent. Another scheme, not generally understood, for the same purpose is the reduction of the travel of the counterweight. By means of a dividing sheave the velocity of the counterweights is made one-half of that of the car; the weight of the counterweights being doubled so that their balancing effect may remain the same. Since the inertia of any mass is proportional to the product of its weight and the square of its velocity, the doubling of its mass and halving of its velocity cuts its inertia in two. The same principle can, if desired, be carried further, the limiting conditions being the increase of friction in the dividing sheaves and the increase of weight on the top of the building. Where a short travel counterweight is used a further gain is possible by attaching the tail chains to the counterweight, thus gaining for them also a short travel.

For high buildings it would seem advisable to locate the machine at the head of the elevator shaft, instead of in the basement. This would do away with all cables running from the head sheaves down to the machine. At first thought it would seem as though elevator machines were too heavy to be placed in the top of a building. Such a construction would, however, rid the head sheaves of the

weight of the cables running down to the machine, and of the tension stress in those cables. These two factors in a high building often amount to 5000 pounds or more. The modern steel construction is also much better fitted to sustain running machinery than the older types of building. With the machine at the top of the shaft the cables could be continuous from car to counterweight, double driving sheaves being used, around which the cables could be wrapped a sufficient number of times to obtain good adhesion, as is done in mine hoists.

Another problem, which becomes serious with rapid running, is the control of the speed. This is due to the variable nature of the load, and to the fact that the speed of a motor in series with a rheostat is dependent on the load. The load of an over-counterweighted elevator motor varies commonly all the way from 50 per cent. above rated load to a 50 per cent. negative or dynamo load. If the motor is controlled by a rheostat designed to give, with an average load, constant acceleration as the resistance is cut out, the motor will, with a heavy load, start up sluggishly at first, and will pick up its speed on the last few segments. If, on the contrary, a heavy unbalanced load is helping the motor, it will jump right up speed on the first few segments. The writer has seen such a motor run up to 30 or 40 per cent. above rated speed as the first part of resistance was being cut out by the elevator attendant, and then slow down again as the last segments of the rheostat were passed, throwing the motor into action as a dynamo on the line. With such a wide variation as this in the rate of acceleration, it is plain that either time will be lost in some cases or the start will be uncomfortably rapid in others.

All sorts of automatic rheostats have been devised to meet this difficulty. In some the rheostat arm is moved by a solenoid connected in series with the armature. The effect of such an arrangement is almost the reverse of what is wanted, as with heavy loads it cuts the resistance out rapidly, while with light or negative loads it is likely to stick and allow the motor to race.

Another arrangement makes the motion of the armature itself cut out the resistance. This naturally results in making the start very sluggish with heavy loads, and all the more abrupt with negative loads. The ideal apparatus is one which will give a voltage at the brushes varying uniformly with the time from zero at the start to full dynamo pressure at a uniform time thereafter. This would give, with a shunt motor, uniform acceleration from a state of rest to full speed in a given time, quite independent of the load. This does not seem a difficult problem on paper, but the requirements of simplicity and almost absolute reliability add to the difficulty. Up to the present the best method of rheostatic control seems to be the operation of the rheostat handle at the will of the attendant, either direct, or by the aid of a pilot motor.

Another problem caused by the variable loads is the difficulty of making accurate landings, and this problem also increases with increase of speed. The mechanical brake, which is customarily used for stopping the machine, is either full off or full on. There is no means provided for the attendant to adjust its retarding effect to suit the load, and therefore the amount of slipping after the brake is applied depends greatly on the condition of the load. If there is a heavy unbalanced load tending to check the motion, the retardation with the brake applied will be abrupt. If a heavy unbalanced load tends, on the contrary, to keep the machine moving, there will be a long slide after the brake is applied. Uniform retardation is as necessary for the maximum speed of service consistent with comfort as is uniform acceleration, and further, variable retardation causes vexatious delays through badly-made landings. With rheostatic control the insertion of resistance when approaching a landing may or may not slow up the machine, according entirely to the load. On this account and because of the non-adjustable nature of the retarding brake, it is impossible to accurately graduate the speed of a car when approaching a floor, as can be done with hydraulic apparatus. The operation of stopping is necessarily effected by cutting off the current and applying the brake at a distance from the floor suggested by experience, and trusting to the slipping of the brake to carry the car to the proper position. If the elevator moves with a speed of 10 feet per second it is obvious that an error of one-tenth of a second in this operation will make a landing 1 foot away from the floor, and it will be necessary to turn on the current and make another try at it. With the slip a very variable quantity, dependent on the load, it is obvious that a high degree of skill is necessary to make accurate landings in high-speed service.

Many interesting attempts at solutions have been called forth by these difficulties. It is plain that the greater the friction in an elevator machine the less in proportion will be the inertia and load variation effects. Some elevators have attained considerable success by having very indirect mechanical transmission. A more scientific method would be to make the transmission more direct and apply a good Prony brake. If the car is under-counterweighted the motor will always work as a motor going up and as a dynamo coming down. The range of loads in either direction will be considerably less than with over-counterweights. Some machines are worked on this principle, throwing away all energy given back in the descent to heat dead resistances.

By far the most interesting solution is what is known as the Leonard system of control. In this each elevator motor is supplied from a separate dynamo, an independent machine being used as an exciter for the others. The motor field is fully excited at all times, and the motor armature is connected to the dynamo armature with no rheostat in the circuit. The dynamo is maintained at speed and its field excitation is controlled by the car attendant. When the car is stationary, the dynamo field is demagnetized. To start the dynamo field is gradually built up, which causes a simultaneous rise of the dynamo armature voltage and thereby a rise of the motor speed. To slow down, the dynamo fields are weakened; the voltage falls, and the motor speed is reduced, the energy of inertia being returned to the prime mover. As the attendant has under his immediate control the difference of potential at the motor brushes he can effect any desired change in the speed of his machine, and that speed will be governed solely by the position of his controlling handle, almost independently of the load.

With this system the excessive currents required to overcome the inertia of starting are not taken at full maximum pressure and largely wasted in dead resistance, but are generated at the pressure desired. Moreover, the kinetic energy taken in the acceleration of the load is partially given back to the dynamo in slowing down. The rate of acceleration and retardation is directly under the control of the attendant. He can graduate his speed and make a smooth, accurate landing with the same ease as with a hydraulic machine.

The disadvantages of the Leonard system are the number of dynamos necessary, none of which—except the exciter—can be simultaneously used for lighting, and the commutator troubles incident on running dynamos with strong armature currents and weak fields.

Another system of accomplishing the desired variation of voltage at the motor brushes has been proposed, by which storage batteries should be used, more or fewer batteries being included in the motor armature circuit, according as higher or lower speed is desired. The difficulty of making the proper traveling contacts in sufficiently rapid succession would probably be serious in such a system.

The effect of speed adjustable by the attendant, independently of load, could conceivably be obtained with rheostatic control and mechanical braking by a pilot motor controlling the armature rheostat and brake-lifting contacts, the pilot motor being differentially controlled by the attendant's handle and a centrifugal switch sensitive to the speed of the main motor.

As elevator speeds become continuously greater and owners become more critical elevator requirements become more and more rigorous. There will probably soon be a demand for a machine that will accurately adjust its own landings to the floor levels automatically, thus doing away with the necessity of such skillful attendants. Because of the inherent ease of control of all electric apparatus it may be confidently expected that, with proper time for development, electric elevators will fulfill the conditions as well or better than any others.

Central Station Statistics.

Those who are interested in central station statistics will find in the *Digest* this week an abstract from what appears to be a very carefully prepared table referring to the central stations in Germany. A fact of special importance is that the efficiencies of the central stations have greatly increased, due to the levelling of the load curve by the more extended applications of motors. The fear that the Welsbach light would interfere with the progress of the electric light is not substantiated by the figures given. The total power represented by all these stations in Germany is 78,237 kilowatts.

DIGEST OF CURRENT TECHNICAL ELECTRICAL ARTICLES FOREIGN AND AMERICAN JOURNALS

COMPILED FROM

BY

CARL HERING

DYNAMOS, MOTORS AND TRANSFORMERS.

Experiments in Dynamo and Motor Design. Lond. *Elec.*, July 3.—An illustrated description of a somewhat odd form of motor, which was the result of some experiments made by Fynn nearly two years ago, the purpose being to have the smallest possible air gap, using slot-wound armatures, without the unpleasant consequences of bad collection. The machine was designed to meet very strict specifications, to satisfy which the magnetic flux in the armature core was not reversed in direction but only varied in intensity in one given direction; the armature was constructed in the form of two cores on the same axis, separated by a collar of considerably smaller diameter; the field poles were arranged around the two cores, all those around one having a north polarity and around the other a south polarity, one set being staggered with respect to the other; there were four poles, forming two pairs, and the field was thus diagonal; the general idea is not new; they were all excited with one field coil; each pole embraced an arc of 90 degrees; the construction favors ventilation; the wires are wound over the two cores and the collar between them as though they all formed one core together. The efficiency was 90 degrees, the exciting current 0.316 per cent. and the air gaps amounted to a total of 3 84 mm, which is 5-64 of an inch at each pole; with copper-gauze brushes the lead was about 1.5 degree at full load, and this had to be set exactly, as the slightest alterations caused furious sparking, although at the correct lead the running was quite sparkless; it is thought that an ordinary motor of about the same dimensions would not run at all sparklessly; with carbon brushes the motor ran sparklessly at all loads without any lead whatever; it has been in use in practice ever since; the total weight, including a heavy pulley, was 95 pounds per kw per 1000 revolutions; the small lead and small temperature rise was therefore not obtained by underloading a large machine. Some illustrations are given; the motor was connected to a pump.

Dynamo Construction. GUILBERT. *L'Eclairage Elec.*, July 17.—Brief illustrated descriptions of some improvements made by Ferranti, Johnson and Steele, Jackson and Lewis, all relating to the methods of keeping the armature coils in place. Ferranti uses a flat coil placed on the inside surface of the ring; there are no cores; Johnson and Steele secured them in a similar place but around short cores; Jackson and Lewis run staples into the core of a drum armature and wind the coils between them.

Winding Drum Armatures. BAXTER. *Amer. Mach.*, July 29.—An illustrated description of an improved method; the armature is suspended as usual, is accessible from one side only, and the reel placed in the direction of the prolonged axes.

LIGHTS AND LIGHTING.

New Incandescent Lamp. DE VITA. *Elek. Anz.*, July 18, and *Elek. Tech.*, July 15; a short abstract from *Elettricita* (no date given).—The low efficiency of the present incandescent lamp is claimed to be due to the fact that carbon is used, and this gives out light only after being raised to a very high temperature; the present inventor uses a substance called "fulgor," the composition of which is at present kept a secret, and he subjects this material to the action of the electric current. The filament is made of a number of platinum wires one-twentieth mm in diameter and twisted or woven together to form a thread, which is then coated with this material; at a temperature of 1000° an intensely white light is given out; these filaments need not be placed in vacuum bulbs, but will burn in the open air or in bulbs filled with dry air. Photometric measurements with such a lamp, containing four of the platinum threads, were made and the results are given in the abstract; the current was obtained from a battery of nine cells and continued for 20 days; the candle power at the start was 17.3, the current 0.9 ampere and the voltage 8.04; at the end of the tests the candle power had diminished only 11 per cent.; the efficiency of this lamp is 0.41 watts per candle at the start and 0.435 at the end.

Standard Candle-Power of Incandescent Lamps.—Lond. *Elec.*, July 23.—An editorial discussion of the recent report to the National Electric Light Association. The report is said to be a business-like document containing a number of recommendations worthy of consideration; but it is thought remarkable that no allusion was made to the Dibdin 10-cp standard lamp, which was the final choice of the English committee; no secondary standard would then be required; it is thought that most people will agree with the recommendations made in reference to the specifications, namely, that the standard lamp should be rated in terms of its mean spherical candle-power; it is not thought that the ideal distribution is one that is uniform spherically, and it is questioned whether there is any real advantage or importance in the way in which an incandescent lamp distributes its light; the walls and ceilings assist in making the distribution uniform; it is thought far more important to place the lamp judiciously than to secure a uniform radiation from each light. It is considered a mistake to measure the quantity of light in terms of candle power, as this preserves the present confusion; the mean spherical candle power of a 16-cp lamp will not generally be more than about 10.

Street Lighting with Rectifiers. KENSIT. Lond. *Elec.*, July 23.—A brief communication describing his experience with those at Blackpool, where four are in use. No difficulty was found in paralleling the machines running on rectifiers; a flash over one side was a very rare occurrence; there is not a single case of one rectifier upsetting the others; running rectifiers on the bus bars was not found to produce a jump in the lights; it is very seldom that any hunting occurred which could not be promptly checked; the exact adjustment of the brushes is of very great importance, and one-sixteenth of an inch or the slightest insufficiency of pressure, will cause hunting, while one-eighth of an inch will cause constant flashing; it is best to let the commutators alone; stiff gauze brushes are recommended for the high-tension side; frequent reversal of direction of rotation is beneficial; a loose contact on the circuit is the most serious cause of trouble, as a rectifier cannot run on open circuit.

Light and Heat.—Zeit. f. Beleucht., July 30.—A short editorial article in which some recent figures by Lewis are given and are then corrected editorially; the Lewis figures give the available heat at the source of light and the amount changed into light, using as a basis 100 lbs. of coal. The corrected figures are as follows, the numbers representing the percentage of the heat energy at the light, which is converted into light; for the arc light it is 10 per cent., for the incandescent 3.2, for the Welsbach 0.8 and for the regenerated arc light 0.42.

Arc-Light Reflectors.—Zeit. f. Beleucht., July 10.—In an article by Gentsch on artificial illumination in schools, an illustrated description is given of the Hrabowski forms of diffuse reflectors, by means of which the sharp shadows of the arc light are avoided.

Vacuum Tube Lighting Apparatus. MOORE system. *Elec. Eng.*, July 29.—A number of illustrations showing the various stages of development of his apparatus.

POWER.

Electric Rotary Drills.—Eng. News, July 22.—An illustrated abstract from *Genie Civil* describing a plant for tunneling used by a coal mining company in France, the power being obtained by water under natural pressure in the strata through which the tunnel is driven; the pressure corresponds to 262 feet and a Pelton wheel is therefore used; a three-phase current operates the electric motors, which are carried on drill carriages mounted on rails, each drill having a separate motor of about 3 horse-power; the drills are forced by hydraulic pressure at the rate of about 3 inches per minute.

TRACTION.

Electric Carriage.—L'Eclairage Elec., June 16.—An article, chiefly of local interest, containing the recent report of the company in Paris, which was noticed in the *Digest*, July 24, and giving an interview with Bixio, which contains approximate estimates of the cost of the various forms of traction for carriages, including animal, petroleum and electric traction, the electric by the Krieger and the petroleum system by the Roger system; the cost for operating a number of these is given as 6512 francs (one franc equals about 20 cents), for the petroleum 5325, and for the electric 4800 per

year per carriage; tables of the detailed costs are given for animal and electric traction per day and per carriage; for the former it is 15.44 francs and for the latter 8.13, while for petroleum it is 13.20, thus showing an economy of 47.34 per cent. in the electric as compared with the animal traction; the present profit is 0.65 francs for animal traction and will be 7.96 for electric traction.

Tramways Institute Papers.—Lond. *Elec. Eng.*, July 23.—A reprint of two of the papers read, with the discussions; the first is by Sellon on "Light Railways," and is merely of local interest; the second is on "Tramway Haulage," by Silcock, and discusses the relative merits and demerits of the various systems of mechanical and horse traction, concluding that the choice lies between the cable and the overhead electric, depending on the grades, the amount of traffic and the frequency of the service; general figures for estimating the costs are given. He concludes that in most cases the costs of the two are equal between a two minute and a three minute service each way; for a greater frequency the cable is cheaper and for a smaller service the electric system is the more economical; in the discussion some of the members differed from the author in his conclusions.

Alternating-Current Traction. MEYER. *Elek. Anz.*, July 15 and 18.—After reviewing and discussing the various systems, he suggests his own, which consists in using single-phase alternating currents, changing them on the car into two-phase currents by the well-known method of dividing the circuit and passing one branch through condensers, these two-phase currents being then transformed into three-phase currents by means of the Scott system and then used to operate three-phase motors; he thinks there is a great future for such a system, the efficiency of which he believes will be very high. Another system is to convert the single-phase currents on the car into direct currents by means of a Pollak rectifier.

Mechanical Traction in Paris.—Bul. Soc. Int. des Elec., March.—The conclusion of a very long discussion in the form of a communication by Francq; it appears to be chiefly of local interest, and refers largely to non-electrical methods of traction.

Efficient Transmission of Power for Railways. CONANT. *St. Ry. Rev.*, July 15.—After stating that the various formulas published are worse than guesses and that others are based on a misapplication of Thompson's law, he gives his formula for calculating the circular mils which he used in certain cases. The formula is simple in appearance, but includes a factor which depends on a large number of considerations, which he discusses at some length; he also shows how his formula is deduced. Some tables and curves for overhead and underground lines give the cost of feed copper per car, the above-mentioned factor, the loss in the feeders, etc., for a road from 1 to 5 miles in length. (The formula is not reproduced here because the description of that factor would be too lengthy.)

Distribution of Current for Railways.—Eng. News, July 22.—An editorial article calling attention to the fact that high potentials are to be used on the new Central London Railway, although the line is only short, 6.5 miles; it seems to doubt the advisability of using high potentials for such a short line, but assumes that there must have been good reasons; some of the advantages which this comparatively new combination possesses are pointed out.

Birmingham Railway Report.—St. Ry. Rev., July 15.—An abstract of the recent report to that city of a committee who compared the systems used in a large number of European cities; some features of the system are described. The committee considered electric traction preferable to all the other systems; storage batteries were not suited for grades exceeding 2 or 3 per cent.; the tenor of the report is that the conduit system would be the best for that city.

Inclined Railway on Mt. Tom.—St. Ry. Rev.—A brief illustrated description of this line near Holyoke; the incline is operated by the balance system with one ascending and one descending car attached to the ends of a cable, the necessary power being applied by the motors of the ascending car, which obtain their current from a trolley line.

Hanover Railway.—St. Ry. Rev., July 15.—A reprint of the abstract from the Lond. *Elec. Rev.*, which was noticed in the *Digest*, June 5.

Monorail System.—St. Ry. Rev., July 15.—A brief illustrated description of the Behr system, to which frequent references have been given in the *Digest* recently.

Railway Repair-Shop Management. PORTER. *St. Ry. Rev.*, July 15.—An article in which he discusses some of the methods of management adopted by some companies.

Elevated Railroads. SHORT. *West. Elec.*, July 31.—An article consisting mainly of working drawings of motors and various parts of the rolling stock for elevated railways, accompanied by a number of curves giving the relations between various factors concerning the running of the motors; there is also a long table which is compiled for the convenience of engineers in making calculations for the required current necessary to operate a given line of road with certain specified trains. He discusses the question of steam traction on elevated roads, showing the limitations and the excessive cost of power, and follows this by the descriptions above mentioned of the standard apparatus of his company (the Walker Company) for elevated lines. They are designed to run with a third-rail system and without auxiliary feeders; a table shows the amount of power which rails of different section will carry with a drop of 100 volts per mile.

Chicago.—West. Elec., July 31.—A brief illustrated description of the Suburban Railway Company system; it is claimed that there is no electric railway in or about Chicago which is operated on conditions so nearly approximating those of steam-railroad service as this one is.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Localization of Faults in Underground Mains. QUIN. Lond. *Elec. Eng.*, July 23.—The beginning of a reprint of a Municipal Association paper. He considers the Berlin automatic system of signalling faults the best, but its cost is practically prohibitive; the next best system is to make arrangements with the local telephone exchange to allow connections to be made, at some time when the service is light, from the mains through a suitable resistance to their exchange earth; this he believes is quite as good a system as the one in Berlin, and not nearly so expensive; it requires but a comparatively small current to drop the indicators when connection is made direct to the exchange earth, but a very much larger current is required when the central is not one of the spheres of influence; when the numbers of the fallen indicators have been ascertained it is not a difficult matter to plot the positions of the telephones on a map and thus find the place of the second sphere of influence; these numbers will soon show whether there is more than one faulty section. The pilot wires can also be used, but as they are not nearly as numerous as the telephones, the method is inferior to the one above mentioned; in using these pilot wires he recommends proceeding as follows: Assuming the fault to be on a negative, then earth the negative bar at the works and take the potential between the negative pole at any feeding point, by means of the negative pilot wires and connect to earth at the works; the feeding point having the least difference of potential to earth is the one nearest the fault. Another method consists in inserting small fuses in the feeders, and it has given very good results; these are inserted at the time of light load between the bus bars and the feeders on the pole on which the fault exists, and are of such a capacity that when two or three blow the remainder will safely carry the load; the insulated pole is temporarily connected to earth at the station, and the order in which the first two or three fuses blow is noted. Another method which deserves mentioning is the one in use at Liverpool; around each feeder is placed a small iron ring wound like a transformer, but with only one coil; steady current will have no effect on an indicator connected to this coil; in making a test the insulated pole is intermittently connected to earth and the throw of the needle on each feeder is measured; with a leak as small as one ampere the throw is quite perceptible. Regarding the lamp-signal method, which is generally used to show the presence of a fault, he states that it is a good method, provided care has been taken to immediately remove every fault; when faults develop or exist simultaneously on both poles the apparatus is not reliable. He describes a differential ammeter method for finding the sections in which there are leaks; it is inserted in the network in the circuit of the feeder from the main network to the section in which the fault lies; the whole current required for that district passes through the instrument; the main network is then temporarily earthed and the deflection of the instrument noted; should the leak be in that isolated district the instrument will show the leakage current in amperes, but if not there is no deflection, as the two opposite currents through the instrument are then exactly alike; if the removal of a certain branch reduces the deflection to zero it shows that the fault was in that branch; the continuity of supply is maintained throughout the whole time of the test; the method is applicable to alternating currents as well as to continuous. Of all the methods described he favors the telephone system, followed up with the leakage-ammeter test. For alternating high tension an electrostatic voltmeter is the best test; to locate the feeder having the fault is not a difficult matter, as separate feeders or separate alternators are generally used; if the alternators are run in parallel, one of them is disconnected and then joined separately to the faulty feeder. He then discusses the accurate location of the position of the fault; the loop test is fairly good for a high-conductor resistance, but fails for large wires, for which he has abandoned it; the telephone and induction-coil method is discussed and it is shown to be unsatisfactory. The paper is to be continued.

Three-Phase Power and Light Plant at Liverpool.—Lond. *Elec. Rev.*, July 25.—An illustrated description of a plant for a grain storage company. It is said to be the first plant in England in which the three-phase system was used exclusively for lighting and power. The plant consists of a direct-coupled set of 180 horse-power; the motor, which is of the Oerlikon type, has no revolving parts which require insulation and therefore no collecting brushes or revolving contacts, as both the armature and the existing circuits are stationary; the results of a six-hour test are given; among the advantages are that no skilled attention is required; that these motors are considerably lighter than those of the direct current type; that they can be placed where the dust, grit and dampness would require other types of motors to be carefully protected.

Switchboards for Arc Circuits. DOW. *Elec. Eng'ing*, July 15.—An article discussing briefly the various systems of switchboards and recommending a panel board with about four sets of dynamo terminals and eight sets of circuit terminals in each panel, the cords being as short as possible; such a board, which has been in use for a number of years and has given great satisfaction, is illustrated.

Municipal Ownership. FOOTE. *Prog. Age*, July 15.—The beginning of a long article on "No Government Should Operate an Industry."

WIRES, WIRING AND CONDUITS.

Test of Fuses and Fuse Wires. LAPORTE. *L'Eclairage Elec.*, July 17.—A long abstract of a recent paper read before the International Society; it contains the results of extensive researches made with the wires themselves and with the apparatus as a whole. After a brief review of the work done by others he gives the results of his experiments; he endeavored to find if a given wire will always fuse for the same current; he found that it was always possible to keep a lead or lead alloy wire at incandescence for several hours, as the metal is covered with an oxide of sufficient mechanica' strength to keep the melted liquid in place; in the non-oxidizing gases they always melt without being heated to incandescence; another cause of the lagging of the fusion is due to the surface tension of the melted liquid; he found that these difficulties may be overcome by covering the surface of the wire with a reducing agent; resin, for instance, gives very good results (it is a question whether the insurance companies would not object seriously to this. Why not use a non-inflammable reducing agent?) He then investigated the relation of the length and the diameter; above a length of 3 to 4 cm and a diameter of 1 mm the lagging in the fusion is negligible; vertical wires fuse more regularly than horizontal ones; he showed the great influence of the amount of metal in the terminal clamps, and concludes with an investigation of the effect of the nature of the metal; lead, copper and alloys of lead and tin were tried; copper was the most regular, but its fusion point was too high. If the length is varied and the fusion currents are made the ordinates, while the lengths are the abscissas, the curve will be approximately an equilateral hyperbola of which the "asymptotes are parallel to the abscissas;" for different diameters of the wire the curves will be similar, but with longer axes for greater diameters; but the curves will always be identical, that is, for the same ratio of the diameter to the length of the fusing current "is indicated by the same point of the curve"; in taking the reciprocals of the lengths instead of the lengths themselves the phenomena can therefore be represented by straight lines, which is very convenient in practice. He also endeavored to verify the law of Preece, namely, that the intensity is equal to a constant multiplied by the diameter raised to the two-thirds power, and found that it was not strictly correct; it can however always be represented by that equation with different constants for the coefficient and the exponent, for each metal; for lead, for instance, the exponent was 1.22 and the coefficient 9.55; for the alloys both were slightly less and for copper the exponent was 1.

Distributing Systems. BLAIKIE. Lond. *Elec. Rev.*, and *Elec. Eng.*, July 23.—A reprint of a Municipal Association paper, the latter journal containing also the discussion. It is chiefly of local interest, and contains descriptions of the underground systems used in England, with special reference to the so-called solid system which is so popular there, and seems to be the most reliable and the cheapest; the mains are laid in iron troughs and filled in solid with bitumen; the cables most largely used appear to be those with a lead-sheathed armor. In the latter part he gives useful information about the construction of the transformer chambers and their cost. The discussion does not appear to contain anything of importance.

Pole Lines. PERRINE. *Elec. Eng'ing*, July 15.—A long article on the calculation of poles and overhead lines, with reference to mechanical strains; this forms part of his long serial on the calculation of circuits.

ELECTRO-PHYSICS AND MAGNETISM.

New Observations of the Properties of X-Rays. RÖNTGEN. *L'Eclairage Elec.*, July 17.—A long article which appears to be the complete one, of which an abstract was noticed in the *Digest*, last week. The instrument for measuring the intensities is similar to the Bouguer photometer; the two halves of a fluorescent screen each receive the rays from the sources to be compared, and the adjustment is made so that the two halves of the screen are illuminated equally; at the conclusion he states that he has found no results which enable him to say with certainty that there is a diffraction of the X-rays.

Actino-Electric Effects of X-Rays. GUGGENHEIMER. *L'Eclairage Elec.*, July 17.—A brief abstract of an Academy note. He found that if two identical electrodes are placed in a liquid, and if one of them is exposed to X-rays, a current is introduced which generally passes from the exposed plate to the other through the external circuit; the intensity depends on the intensity of the radiation, and if the latter is intense the current changes sign during the experiment.

Cathode Rays. WIEDEMANN and SCHMIDT. *L'Eclairage Elec.*, July 17; abstracted from the *Wied. Ann.*, 60, p. 510.—They discuss the subject of the alleged interference surfaces in the neighborhood of the cathode and the electrostatic repulsion of cathode rays; they found that the resultant surfaces do not appear to be interference surfaces in the correct sense of the word, and it is not correct to deduce from their properties results concerning the relative wave length of the cathode rays; also that the electrostatic deviation of these rays is not a primary phenomena but a secondary one, due to the perturbations of the electric field.

Magnetic Deflection of Cathode and X-Rays. METZ. *L'Eclairage Elec.*, July 17.—An Academy note in which he shows that the photographs which he described over a year ago were really due to cathode and not to X-rays; he also showed that cathode rays retain their nature and are not necessarily converted into X-rays while being reflected from an object; he found that the reflected rays are capable of being deflected by a magnet, a north pole attracting the beam and a south pole repelling it; the question then arises how to distinguish between cathode and X-rays.

Partial Polarization of Light in a Magnetic Field. EGOROFF and GEORGIEWSKY. *L'Eclairage Elec.*, July 17.—An abstract of an Academy note describing experiments, some of which were similar to those of Zeeman; they also found that the luminous intensity of a Bunsen burner was increased by a magnetic field.

Effect of Tension on the Dielectric Constant of Glass. CORBINO. *L'Eclairage Elec.*, July 17; noticed briefly in *Beiblaetter*, 3, p. 238.—He finds that a tension perpendicular to the lines of force diminishes the dielectric constant proportionally.

Arc and Spark. GUILLAUME. *L'Ind. Elec.*, July 10.—A few remarks discussing the question when a discharge is an arc and when it is a spark; he cites some experiments which can be explained on the assumption that the gas under the action of a spark is partially dissociated; the effect of blowing into the arc is explained by the fact that a current of air removes these ions, and the gas therefore becomes insulating. He then discusses the arc under pressure, with special reference to the curious results obtained by Wilson and Gray, published over a year ago, describing experiments with an arc under pressure; he states that a solid or liquid body can disappear in the atmosphere in a way which is different from simple evaporation; there can be formed a dissolution of the body in the surrounding gas, the numerical factors concerning this dissolution being entirely different from those concerning evaporation; the quantity dissolved increases with the pressure; when applied to the arc it appears that the carbon may be dissolved in the atmosphere and that the temperature of the arc is limited by the rapidity of this dissolution; he advances this theory as a possibility.

Specific Inductive Capacities. GUILLAUME. *L'Ind. Elec.*, July 10.—A few remarks on these capacities and the law of Maxwell concerning the relation of the specific inductive power to the indices of refraction; he refers chiefly to the work of Dewar and Fleming at low temperatures, with a view to remove the apparent contradiction of the results for water and alcohol; the specific inductive power for water increases as the wave length diminishes, but this is not the case for alcohol. This is followed by some remarks on the known spectrum with reference to possible causes of the above-mentioned anomaly; the unknown space in the spectrum includes only six and a fraction octaves; within the last year it was reduced by two octaves, and there is good reason to believe that it will soon be reduced to nothing; he suggests that it is in this unknown space that this electric anomaly, which has occupied the attention of numerous physicists, is to be looked for; he discusses this briefly and concludes that the cause should be looked for in the associated molecules whose vibration period is relatively long and perhaps of the order of magnitude of the Hertzian vibrations.

Distribution of Alternating Currents in Cylindrical Wires. MERRITT. *Phys. Rev.*, July.—A long article giving a complete mathematical discussion of the phenomenon of what is called the skin effect, that is, the limitation of the current to the external layers of the wire when the frequencies are high; he represents the results in such a form as to give a good idea of the nature and magnitude of the effect; he does not assume Maxwell's equations as already derived, but starts from the fundamental physical laws and gives a brief outline of a method for solving the problem; in a table he gives the ratio of the alternating-current resistance, and that offered to steady currents; he shows that the phase of the current at the centre of the wire lags behind that at the surface, the amount in a numerical example which he gives being almost 180°, which means that when the surface current is at a maximum in the positive direction the current at the centre of the wire has just reached its maximum in the negative direction; he discusses the distribution of the current in the cross-section at any definite time and gives a number of curves; this concentration of the current at the surface means a real change in the resistance as the available cross-section is diminished, and it is therefore different from a mere change in the impedance of the circuit; the ratios above mentioned are shown graphically in the form of a curve for a copper wire 1 cm in diameter.

Improved Adjustable X-Ray Tube. SWINTON. *Elec. Eng.*, July 29.—An illustrated description of a tube which is an improvement over the similar one recently described; it is more easily and cheaply constructed and more readily adjusted, besides having a greater range of adjustment; in adjusting it the position of the origin of the rays is not interfered with. The essential feature consists in mounting the cathode on a steel rod sliding in two aluminum guides supported on a glass tube; the whole arrangement is used in a horizontal position, and by simply tapping it at one end the cathode can be made to move to a small extent; the exact position of the cathode relatively to the glass walls of the tubular neck and bulb was found to have an enormous effect on the penetrative value of the X-rays produced; such a tube can be set for rays of any penetrative power.

Induction Phenomena in Alternating Circuits. MILLAS. *Phys. Rev.*, July.—The conclusion of the article which was noticed in the *Digest*, Oct. 17. It refers to an experimental study of such phenomena; in the present

portion he discusses resonance in such circuits; the results are given in curves and tables, but no general conclusions seem to be drawn.

Conversion of Electric Energy in Dielectrics. Threlfall. *Phys. Rev.*, July.—A continuation of his long article, the first part of which was noticed in the *Digest*, May 29. He gives experimental results obtained with a number of different materials; the article is to be concluded; no general conclusions are given in the present portion.

New Form of Cathode Discharge. Wood. *Phys. Rev.*, July.—A preliminary communication which is a more extended report of his experiments, of which a short report was noticed in the *Digest*, April 17 (see also May 8); the cathode rays were produced by a sort of arc between two terminals in a vacuum tube.

ELECTRO-CHEMISTRY AND BATTERIES.

Accumulators for Rapid Charging. Blanchon. *Bul. Soc. Int. des Elec.*, March.—A reprint in full of the long paper, which was noticed in the *Digest*, April 17 (see also May 1). He shows that the solution of the problem can be looked for only in the plates formed by the Planté process, and describes those made by the French Tudor Company, in which the plates are very deeply ribbed, thus giving an enormous surface; the formation is by a rapid process and is only 0.1 mm in depth; the active surface per kilogram of electrode is 20 sq. dcm, and in some forms as much as 25 to 27, while in the best of the pasted plates it is only 3 to 5; the useful capacity at slow rates of one ampere per kgr of electrode is 6 5 to 8 ampere hours, and 3.5 to 4 ampere hours for a rate of 5 to 6 amperes per kgr of both electrodes; with the best pasted accumulators it is 8 to 10 ampere hours per kgr at the rate of 0.5 kg of electrode, 6 to 8 at one ampere and 3 at 2 amperes per kgr; while the pasted plates have a larger capacity than the Planté at slow rates, they are much inferior at rapid rates. At a discharge of only half an hour the current density does not exceed one ampere per sq. dcm, which rate is already exceeded for a three-hour rate for the pasted plates; this shows why the pasted plates have lately been abandoned. The curve for an accumulator is given, showing the capacity at various rates of discharge; it refers to the new form of Tudor accumulator. For traction purposes his company makes cells which are relatively light, but for a mean capacity, instead of going to either extreme; only about two-thirds of the total capacity is used and it is preferred to charge the battery on the car, as this saves expensive manipulations; this charge never exceeds 20 minutes, and is often only 15 and 12; he quotes from various authorities showing the advantages of charging at a constant potential instead of with a constant current; in this way at the end of one hour 45 per cent. of the ten-hour capacity has been received by the accumulator; the curve for such a charge is given, the voltage being 2.5 to 2.6; the current starts at 180 amperes and falls to 110 in 20 minutes; the complete weight is 18.1 kg and the one-hour capacity is 60 ampere hours; in 20 minutes it can be charged with 46 ampere hours, which is 76 per cent.; 40 ampere hours of this is used in the discharge. He then discusses the three methods in which accumulators are used in traction, favoring the mixed system used in Hanover, but concluding that the simple accumulator system will be the best for Paris, with special reference to the Puteaux line; each car carrying 56 passengers has 200 cells of 18.1 kg each; they are always used in series; the total weight is 3.5 tons of accumulators for a heavy car weighing 7 tons; the high cost of the accumulators is largely due to the excessive cost of the retaining cells. In the discussion, Korda stated that 370 watts per car kilometer were required in the line at Berlin, 510 watts at Stuttgart, 470 at Strassburg with heavy cars, and 650 at Hanover with light cars and a level road. Margaine gave some data for the Blot accumulators, in which a 15-minute charge gave 34 ampere hours with a watt efficiency of 66 per cent.; the effective capacity per kgr of electrodes is 4 to 5 ampere hours; this was obtained from 600 charges and discharges; with a charge of 50 minutes a useful capacity of 7.5 to 8 ampere hours per kgr of electrodes was obtained.

Gold Extraction. Andreoli. Lond. *Elec. Rev.*, July 23.—The beginning of an article on the Cassell gold-extraction process; this process, which is about being introduced into England, is criticised very unfavorably; bromine is used, being produced electrolytically; ordinary bromine would be much preferable to that obtained electrolytically, and it is not a better solvent of gold than chlorine; the electrolysis of bromide of potassium could not be stopped by Cassell's patents.

Recovery of Gold. Andreoli. *Eng. News*, July 22.—An abstract of a recent paper read before the Society of Chemical Industry in London. He found that a peroxidized lead plate, as used in accumulators, serves as a very good anode; he used, with good results, cathodes of amalgamated perforated copper standing in troughs of mercury at the bottom, which are connected to the circuit, thus doing away with the troublesome terminals; there are 50 cathodes in a tank to only five to six lead plates. Four of these tanks do the same work as eight ordinary tanks. He also recommends the use of iron plates on which the gold is deposited, as this metal takes the gold much more readily than the lead; to strip them of the gold they are dipped for about one minute in a bath of molten lead or bismuth.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Methods of Registering Alternating Current Curves. Abraham. *L'Eclairage Elec.*, July 17.—An abstract of a recent paper read before the International Society; a longer reprint is promised in a subsequent issue. He enumerates the various methods which have been suggested and described, discussing their relative merits and faults, and then describes an ingenious solution of the problem by a method which he devised and in which he obtains deflections proportional to the instantaneous value of the current, not by neglecting certain terms but by counterbalancing the retarding forces by the action of the current itself; he does this by passing through the galvanometer not the principal current to be measured but another one which is formed of a union of three currents, the first a shunt of the principal current, the second an induced current of the first order, and the third an induced current of the second order. The sensitiveness of the apparatus and the correctness of the results are claimed to be marvelous and the paper is said to have been greatly applauded when read; he calls his apparatus a rheograph. He showed that the curves obtained in practice by the usual methods are far from being as regular as was indicated, as those apparatus indicate only the mean values; with this apparatus and with a current from a dynamo whose brushes are sparking, the effect of each commutator bar passing under the brushes is shown distinctly on the curve. To show the practical importance of such a method in connection with alternators he gives three curves of an alternator, one when it was running unloaded, another when connected with an unloaded transformer and another when connected with a fully loaded transformer; the first curve was very irregular and differed very greatly from the theoretical sine form, but approached it in the second case and was nearly a perfect sine curve in the third. (A brief description of what appears to be the same apparatus was noticed in the *Digest*, last week.)

Shop Measurements with Telephone and Bridge.—St. Ry. Rev., July 15.—A brief description of the bridge method of measuring the resistance of motor fields and armature cores in railway shops, the telephone being used in the place of a galvanometer, the current being interrupted by means of a key placed in the telephone circuit; when balance is reached no click should be heard when this key is moved. (It might have been added that it is very necessary to wait a moment after the current has been started, before closing the telephone key, in order to eliminate the effects of the large self-induction of the coil to be measured.)

TELEGRAPHY. TELEPHONY AND SIGNALS.

Air Space Submarine Cable.—Lond. *Elec.* and *Elec. Rev.*, July 23.—A short description of the Smith and Granville form of cable, in which the electrostatic capacity is reduced to a minimum by the substitution of air for gutta percha between the conductors; such a cable has recently been laid in the Solent; it is said to be a practical outcome of the one recently designed by Preece, but paper is not used; the outside of the cable is round, the four wires are at the corners of a square and the space between them is air, the wires being covered with gutta percha to hold them in place; it is thus a hollow tube closed at intervals by partitions to divide the air space into watertight compartments; the conductors form a spiral with one twist in every eight inches; short lengths have been subjected to hydraulic pressure of 700 pounds per square inch, during a long duration, without apparently altering the shape and without percolation of water; tests of the cable as laid showed a capacity of 0.095 microfarads per nautical mile between the diagonal wires; a severe test was made by telephoning through one pair of the conductors, while the other was in circuit with a powerful alternating current; no disturbance could be detected; the illustration shows the relative proportions of the London-Paris cable, the one under discussion, and the equivalent of the latter, which would have the same capacity and copper resistance, when made in the form of four separately insulated cables; each of the latter is about as large as the one under discussion and the amount of gutta percha required is between five and six times as great. Editorially it is anticipated that this type of cable might be used successfully in deeper waters, but whether it would answer for ocean depths remains to be seen; editorially it is thought that this new cable is an important step toward the practical solution of ocean telephony.

Telegraphy without Wires. Guillaume. *L'Ind. Elec.*, July 10.—A few remarks on the experiments of Preece and Marconi, with an illustrated description of the ingenious apparatus devised by S. P. Thompson, which was used by Preece in his recent lecture as a mechanical analogy of the propogation of electric waves. The apparatus consists essentially of a row of balls suspended so that they can move perpendicularly to the direction of the row; the oscillator is at one end and the resonator at the other; the representation of the phenomena is said to be very correct and the apparatus is praised highly.

Registering Receiver for Submarine Cables. Ader. *L'Ind. Elec.*, July 10.—A reprint of the Academy note, an abstract of which was noticed in the *Digest*, July 17.

Working of Long Submarine Cables. Sayers and Grant. Lond. *Elec. Rev.*, July 23.—The conclusion of the reprint of their paper (see *Digest*, July 24). They give illustrated descriptions of the instruments and systems in use.

Polarising of Telephone Receivers. Giltay. Lond. *Elec.*, July 23.—A translation of the article which was noticed in the *Digest*, July 3.

Signals for Electric Railways. Parrish. *L'Eclairage Elec.*, July 17.—A description of a system for crossings.

MISCELLANEOUS.

Production of Rubies.—Elek. Ans., July 18.—A brief note stating that Gin has succeeded in producing rubies of a weight of hundreds of kilo-

grams by mixing in the electric furnace the vapors of aluminum oxide with those of other substances. No further description is given, but it is stated that in considering the patent application the German patent office wished to see the product, and received in return an enormous ruby block, after which his patent was immediately granted. The ruby consists of crystallized aluminium oxide colored with an acid compound of potassium and chromium. (In another source it was stated some time ago that large gems were now being made by fusing a lot of small ones together in the electric furnace.)

Calcium Carbide Furnace. REGNOLL system. *L'Eclairage Elec.*, July 17.—A brief illustrated description of the one recently installed at the first calcium carbide factory in Italy, near Ivrea; it is for continuous action and the electric energy is used economically, as the waste heat and the carbon monoxide are largely recovered; the material is heated before it is fed into the furnace. According to the test the furnace should produce 200 grams of carbide of calcium with 735 watt hours, that is 1 kg for 5 electrical hp hours; the present furnace requires 50 kw; at present 1000 horsepower is in use, which can be doubled if necessary.

New Remedy Against the Phylloxera.—Cosmos, July 17.—A note stating that Fuchs has found a remedy which consists in pricking the stalk of the vine with a needle submitted to the action of an electric current, which is said to develop ozone, which in turn causes the parasite to leave the vine but does not affect the vitality of the plant; it is stated that transportable accumulators are used; it appears that the application is repeated in the second and third year, and that the parasite is then exterminated; the cost of the treatment is given as $31 per hectare, which is about the same as that for the usual methods.

Electricity at the Brussels Exhibition. L'Eclairage Elec., July 17.—An article on the electrical exhibits; it appears to be little more than a mention of the exhibits and the exhibitors.

Magnetic Concentration. WETHERILL. *Eng. & Min. Jour.*, July 24.—A continuation of the long illustrated description of the plant at the Mine Hill deposits in New Jersey.

Book Review.

THE POLARIZING PHOTO-CHRONOGRAPH. By Albert Cushing Crehore, Ph. D., and George Owen Squire, Ph. D. New York: John Wiley & Sons. 150 pages and numerous folding plates. Cloth.

In this book are embodied the various papers by the authors treating of the same subject, which originally appeared in the *Journal of the United States Artillery*. These are supplemented by Professor Crehore's paper, "A Reliable Method of Recording Alternating Current Curves" which was presented at the annual meeting of the A. I. E. E., Philadelphia, Pa., May 17, 1894.

The development of the polarizing photo-chronograph, its application to the measurement of the velocity of projectiles and an account of the experiments made with this apparatus are very elaborately treated by the authors. It is unnecessary here to speak of the value of these investigations. Their previous appearance in the *Journal* has already aroused the universal attention not only of those who are directly interested in this particular field, but also those who are interested in scientific achievement.

The polarizing chronograph, aside from its application to the determination of projectile speeds, lends itself to the accomplishment of many other important results.

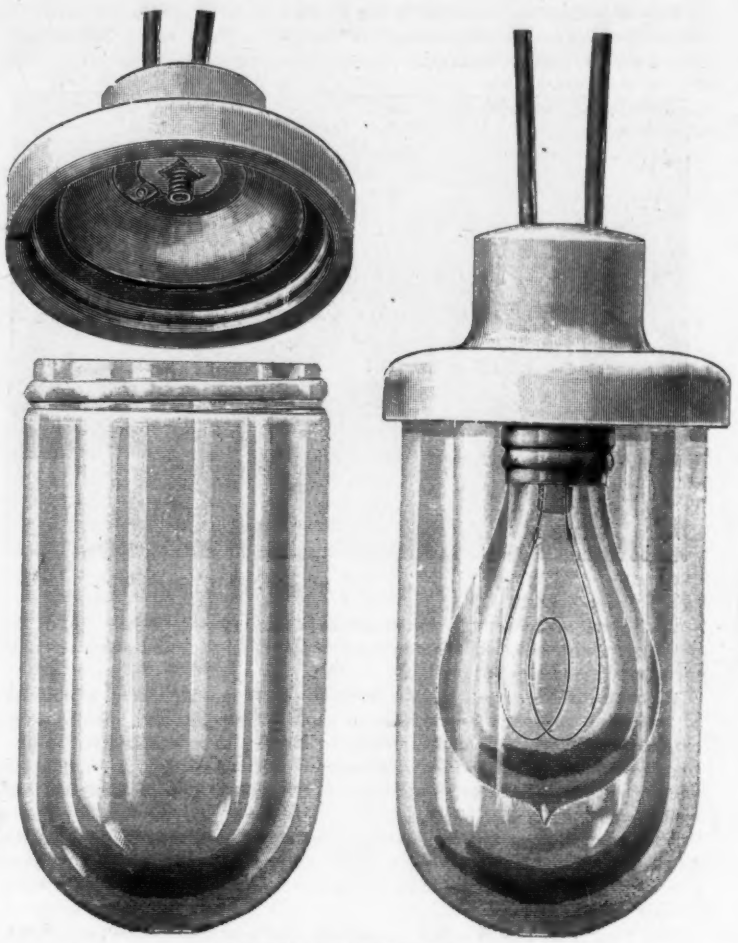
Already the authors have applied this recording instrument to telegraphy, and unquestionably have in mind many similar uses when the transmission and recording of impulses must be accomplished in almost infinitesimal time.

Waterproof Receptacle.

The Newgard waterproof receptacle is a combination of waterproof socket and waterproof globe complete in one appliance. As will be seen from the accompanying illustration, a single piece of porcelain forms a socket or receptacle for the lamp and the cover for the globe. The conducting wires are permanently sealed in this porcelain cap, which is threaded into the receptacle, and the glass globe and rubber gasket in the cover make a water-tight fitting between the cover and the globe, making an outfit which can be used under water with perfect safety.

This receptacle finds its largest field of usefulness in breweries, packing houses and similar work where it is customary to wash the floors, walls and ceilings with showers of water. It will also be found useful in all places where severe conditions have heretofore made a perfect insulation of lamp and socket an impossibility, such as cold storage warehouses, paper mills, etc.

The receptacle is made regularly with the T.-H. base, but can be used with an Edison lamp by the use of a T.-H. adapter. The globe will take either a 16 or 32-cp lamp, the opening in the globe being 2¼ inches.



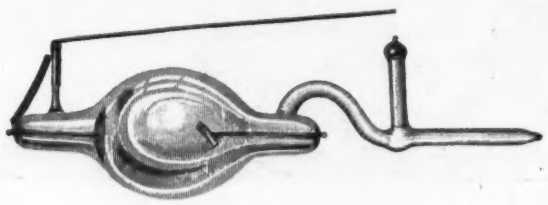
WATERPROOF RECEPTACLE.

The length of the globe is 6 inches, while 7 inches is the length of the outfit over all.

Although just introduced, several hundred of these outfits have already been placed in a number of Chicago breweries, and the results are said to have been most satisfactory. The Electric Appliance Company, Chicago, will be glad to give further information on this specialty.

Adjustable Vacuum Tube.

The Swett & Lewis Company, of Boston, the well-known manufacturer of X-ray and photographic supplies, has just put upon the market a new adjustable vacuum tube which is attracting much attention. It is a very simple thing, as will be seen by the cut shown herewith. The tube is of the regular type made by this firm, with the addition of a chemical bulb

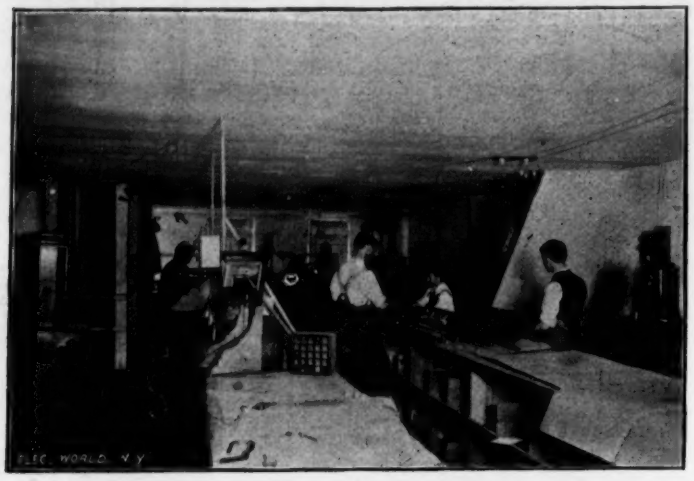


ADJUSTABLE TUBE.

and a pointer. To operate the tube, it is connected up in the usual way. The pointer is set so that no spark passes from pointer to chemical bulb. When the vacuum gets up to the desired point, set the pointer so that an occasional spark jumps across the air space. This will force a small amount of gas into the tube and lower the vacuum. This continues at intervals while the tube is in use. With this attachment, a tube can be run for a long time without attention or increase in vacuum. These tubes are selling very rapidly.

A Prominent Telephone Factory.

Starting in a humble way two years ago with a single workman and equipped with a small lathe, the Phœnix Interior Telephone Company, New York, has, step by step, built up a constantly increasing business, and to-day occupies a large five-story factory with a working force of upwards of 60 employees. At the front of the ground floor of the factory are the offices of the president, Mr. George W. Sutton, and the vice-president and treasurer, Mr. John H. Scofield. The rear portion is devoted to the shipping department, where is located an elevator, running to the top of the building, which facilitates the delivery of the finished and raw material to the various departments.



A Part of the Switchboard Room.

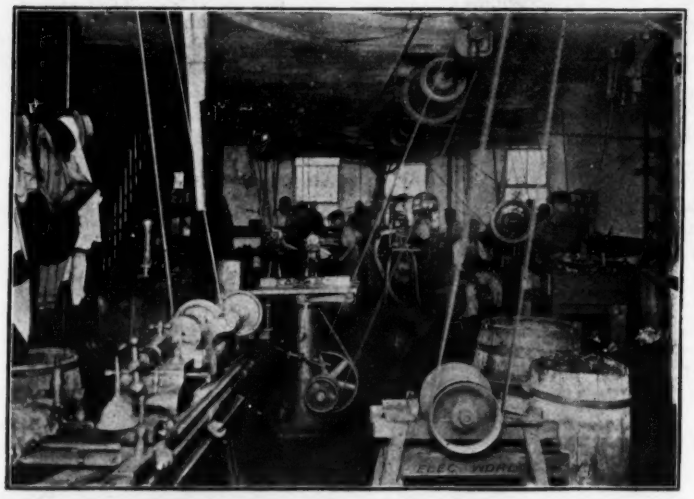
One End of the Assembling Room.

The whole of the second floor is devoted to the machine shop, which contains a very complete assortment of monitor, engine and speed lathes, single and triple spindle drills, milling machines, saw lathes and the like, together with a great variety of special tools and dies for turning out every portion of the metal work used in the company's instruments and switchboards.

A thoroughly equipped nickel-plating plant, consisting of a plating dynamo, with the necessary vats, power buffers, etc., takes up a portion of the third floor, the remainder being used for storing finished wood work, copper wire and the like.

The fourth floor is devoted to making and assembling the parts of the magnetos, winding, receiver, armature and induction coils, and setting up switchboards.

The top floor is used as an assembling room, where the complete sets are set up and thoroughly tested before being shipped. In a gallery running nearly around the room a large force is engaged in making bipolar receivers and the well-known Sutton microphone, so called from the inventor, Mr. George W. Sutton. With characteristic foresight, the company has installed a 30-hp engine and boiler in the basement, which furnishes power to the entire building, and in addition drives a 125-light dynamo, supplying an abundance of light to each floor.



A Corner of the Machine Shop.

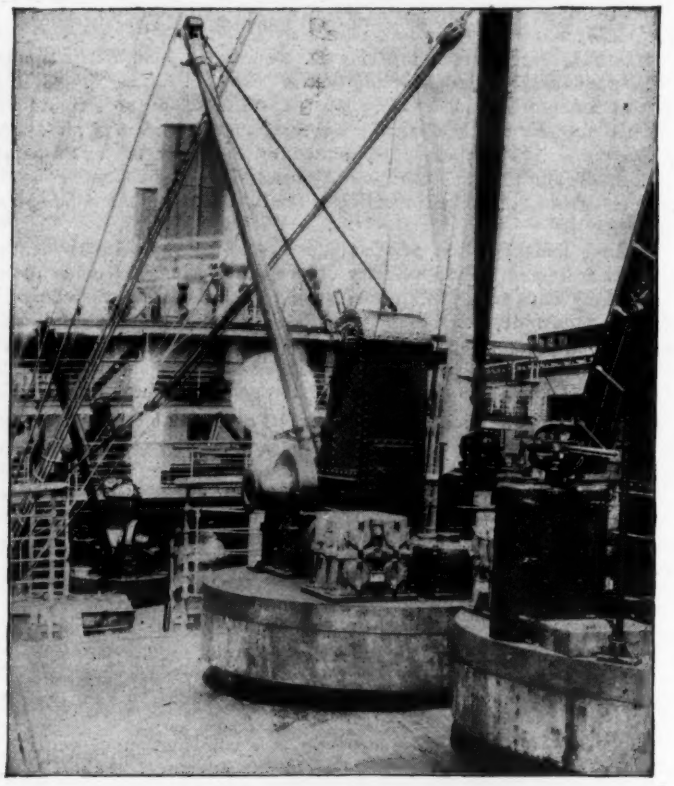
The field magnets of the magnetos, after being heated in a case-hardening furnace, are here quickly bent into shape by a special tool, and after a reheating are suddenly cooled. They are then magnetized by being placed between the poles of a large electromagnet about which are wound over 125 pounds of copper wire.

The company has recently perfected a self-restoring drop (patents for which are pending), which is extremely compact and simple in operation, and which is used in connection with its new switchboards. These are handsomely finished in either maple or mahogany, with a capacity of from 10 to 1000 or more subscribers, and take up but very little space.

The specialties of the Phœnix Interior Telephone Company comprise a variety of styles of telephone sets, switchboards, microphones and receivers for supplying exchanges and buildings, and the splendid facilities enable a high grade of work to be turned out. The instruments have met with such favor that plans are already laid for doubling the capacity of the factory.

Electric Power on a Steamship.

The steamship "Bremen," of the North German Lloyd line, which recently made her first transatlantic trip, is, perhaps, more fully equipped electrically than any other vessel of the merchant marine in the world. Aside from the usual electric lighting plant, she has a very complete and most novel power plant, the successful operation of which is now fully conceded.

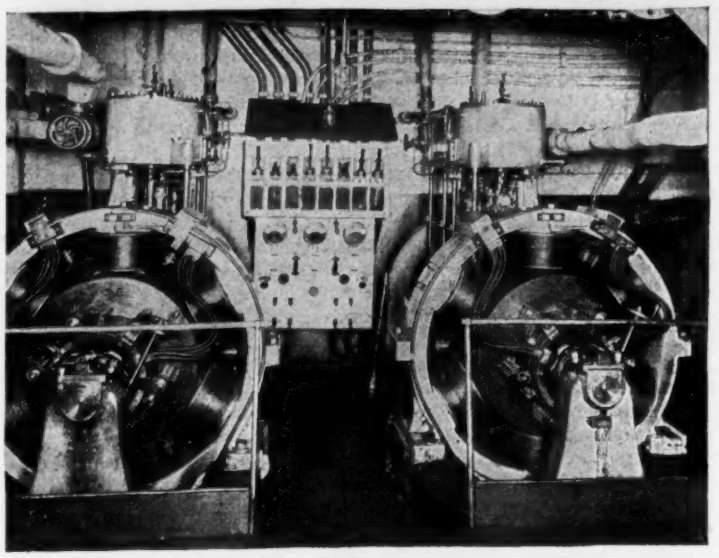


Cranes Showing Operating Handle.

The first power installations on the steamers of the North German Lloyd were made by the Union Electricitats Gesellschaft, of Berlin, the German ally of the General Electric Company, of Schenectady, N. Y., on the steamships "Darmstadt" and "Prinz Heinrich." In these two cases the familiar and noisy donkey engines were superseded by electrically operated winches, and it was the successful operation of these that determined the

North German Lloyd to extend the use of electricity to the "Bremen." In this case, however, in lieu of winches, a full equipment of electric cranes was installed. These cranes are sixteen in number. Four of these have a capacity of 3000 kilograms or 6614 pounds, and twelve of 1500 kilograms or 2307 pounds, and have a total swing outboard of 20 1-2 feet.

The power-generating plant consists of four dynamos, each directly connected to its own engine. The dynamos have each a capacity of 75 kilowatts or 100 horse-power, and run at a speed of 210 revolutions per minute,



STARBOARD DYNAMOS ON THE STEAMSHIP "BREMEN."

delivering current at a pressure of 105 volts. The output of two dynamos is used for the cranes; one is used for the lighting of the ship, and the fourth dynamo is held in reserve in case of accident or other emergency. The engines are of the triple-expansion type, and were built by Schichau, of Elbing, near Dantzig.

The most notable feature of the electrical equipment is the cranes, the lighting installation conforming to the standard practice.

The cranes, motor and controlling mechanism are mounted upon a circular iron platform which revolves upon a pivot. This is turned by a motor of 7 horse-power running at 700 revolutions per minute, directly coupled to a worm gear which in turn meshes in a gearing bolted to the deck. The loads are raised by a 25-hp series motor, running at a speed of 900 revolutions, and driving a special worm gear meshing into the gear of the drum. On the gear end of the drum shaft is fitted a winch head.

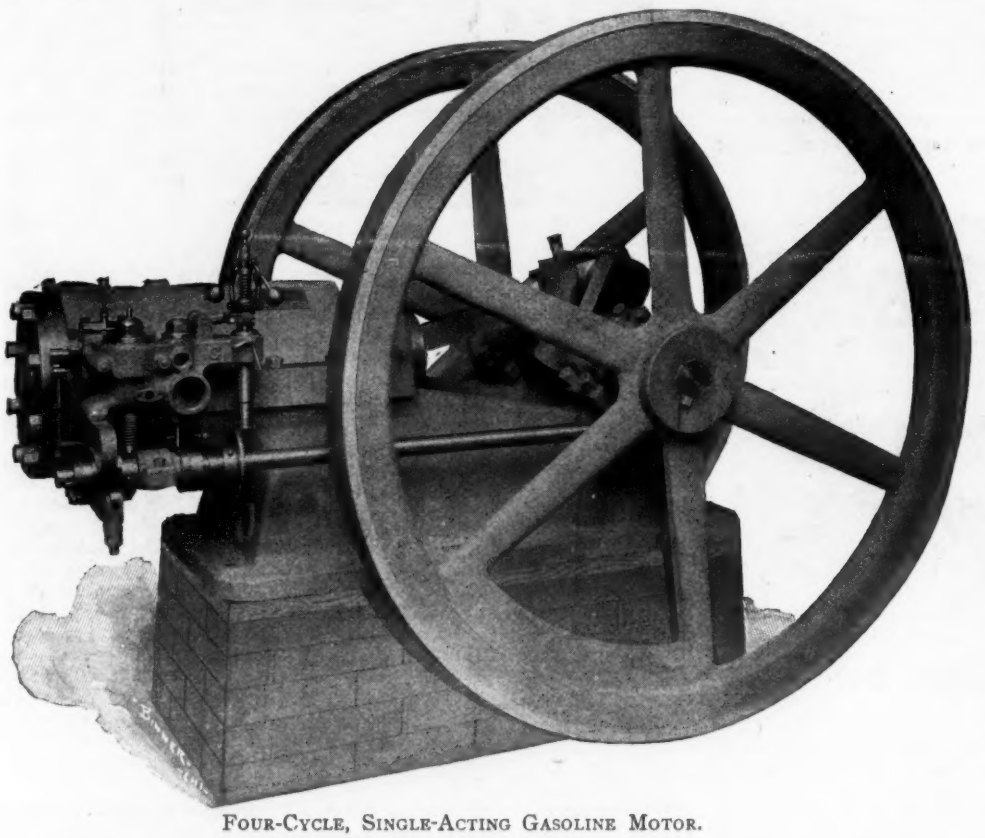
The controllers resemble a double street-car controller about 2 feet high. They are fitted with magnetic blow-out, any spark being immediately extinguished in a magnetic field. The contact cylinders are operated by a special mechanism actuated by a simple handle or lever, the movements of which correspond to the movements of the load. Raising the handle raises the load, depressing the handle lowers the load, and movement of the crane to the right or left is obtained by corresponding movements at the lever. Raising and swinging movements can be effected simultaneously. Motors and controllers are water-tight and dust-tight, but the cases of both can readily be opened when necessary. To give a more perfect control both motors are provided with band brakes operated by the foot. These brakes are attached to an extension of the motor shaft.

The difference between the large and small cranes lies in the hoisting speed. Practically both cranes are identical in electrical equipment, but the hoisting speed of the 3000-kilogram crane at full load, 60 feet per minute, is only half that of the 1500-kilogram crane at full load, 120 feet per minute. The movement of the jib of the cranes is 13 feet per second.

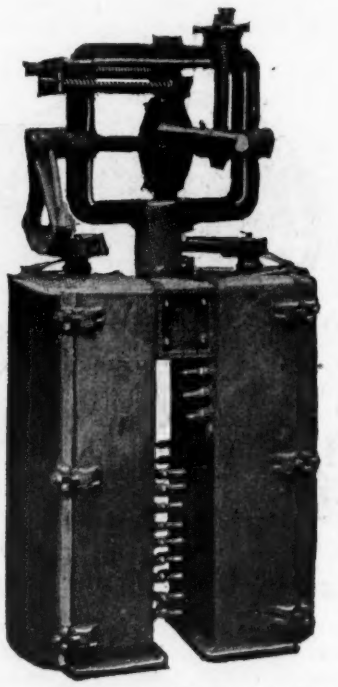
Gasoline and Gas Engines.

For many years the high economy and efficiency of the so-called explosion type of engines have been recognized. It is only of late, however, that these machines have been brought to the practical operative success which now characterizes them. For certain purposes of isolated development of power, as in the case of certain kinds of mine pumping, of the lighting of summer-resort hotels and other places where fuel is expensive, or where the conditions are such that its haulage is unusually difficult, the gasoline motor, employing at the highest efficiency a most concentrated fuel, has proven itself especially adaptable. In connection with small generators for lighting purposes the gasoline motor is making for itself a new field. It can be employed in situations where any other form of motive power would be out of the question. In large stores, wholesale houses and office buildings the gasoline engine can be used to operate elevators, both passenger and freight, as well as to furnish electric light.

The type of gasoline motor herewith illustrated is a four-cycle single-acting engine. It is of the so-called self-scavenging pattern, the governor operating on the inlet fuel valve. By this means when the engine runs above speed, or on light loads where only an occasional ignition is required to keep the engine up to speed, instead of drawing in a partial mixture of vapor and air, only pure air is admitted to the cylinder. This process not only cools the cylinder and valves, but clears them of the products of combustion. The compression of the pure air which takes place in the cylinder is practically balanced by its immediate expansion.



FOUR-CYCLE, SINGLE-ACTING GASOLINE MOTOR.



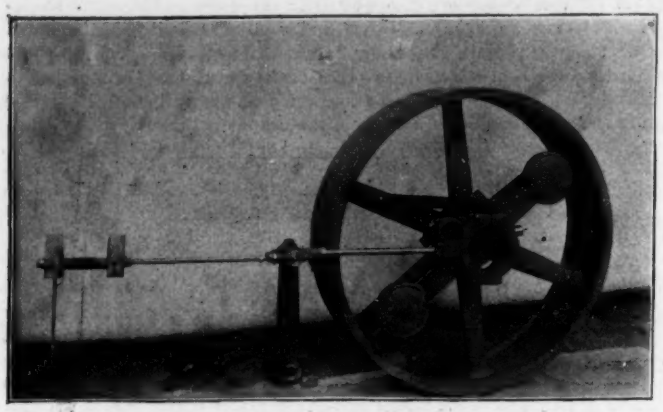
CONTROLLER WITH UNIVERSAL GEAR, STEAMSHIP "BREMEN."

These engines are also built to use either natural or illuminating gas, and are manufactured by the New Era Iron Works, Dayton, Ohio. They are built in sizes from 8 to 60 horse-power, the smaller sizes operating at about 200 revolutions per minute.

A New Type of Economical Automatic Engines.

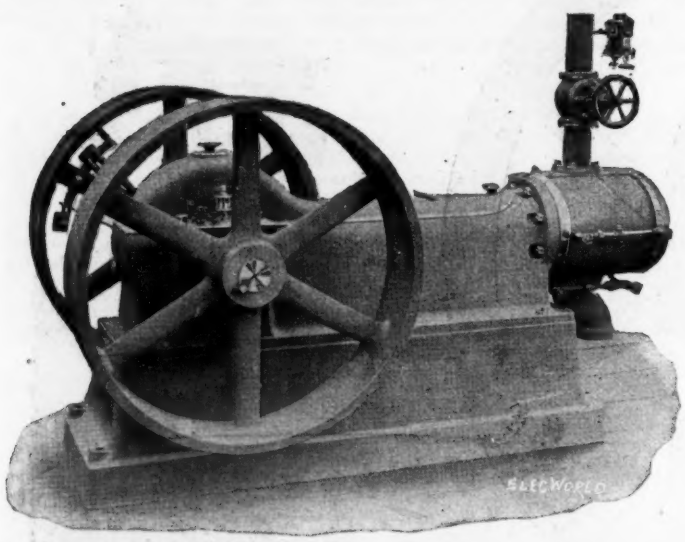
Of the many first-class engines now on the market designed to meet the exacting requirements of electrical practice, none is better suited for this class of work than the "Economic" automatic engine manufactured by the J. B. Allfree Manufacturing Company, Indianapolis, Ind., whose Eastern representative is the firm of H. M. Sciple & Co., Philadelphia, Pa.

In the operation of these engines little more can be desired in the matter of close and quick regulation under all conditions of load, and in their construction the company has kept in view the importance of a proper degree and distribution ot strength and weight, simplicity of arrangement and a due regard for symmetry of form.



Valve and Rites Governor.

All parts of the machine are made to gauge and are interchangeable for all engines of a given size. The governor used is the simplest form of the Rites system, with such improvements as to bring it to a high state of perfection. The valves are of the piston type, of a triangular form or V shape, and take steam on the inside. The outer cover of the steam chest contains only the exhaust steam and affords inspection of the valve under steam. This form of valve has the same perfection of balance possessed by the circular piston valve, admitting steam entirely around it, and at the same ime affording a ready and simple means for taking up wear so that the valve may always be kept tight. As the valve stem has only to be packed against the exhaust steam, and as the valve is very light, the regulation obtained by the combination of these important elements is found to be little short of phenomenal. This unusual result may be explained by the wide margin left between the energy necessary to operate the valve and that



Centre Crank "Economic" Single Engine.

stored up in the governing mechanism, thus leaving the governor with little to do but regulate. The piston is long, and is made hollow to afford strength and lightness. This description applies to both the centre and side crank-engines.

The centre crank engines are especially designed for electrical and other purposes where high speed and extremely close regulation are required. The working parts are entirely closed yet easily accessible. The engines are compact, requiring little floor space, and have the strength of the material distributed in straight lines in the direction of the strains, thus combining strength with neatness and simplicity.

There is found in these engines a feature which appears to be new and is certainly of great value when its effects are observed. A large amount of material is massed between the cylinder and crank for the purpose of destroying or absorbing shocks or vibrations that continually pass through from end to end of the frame or bed. While these masses are introduced for the special purpose of receiving, and, like an anvil, absorbing the shocks, they also add greatly to an already unusually strong and stiff bed. It was found in the development of these engines that after these masses were introduced the friction was lowered and the general efficiency materially raised.

The balancing discs are unusually large and heavy. These are bored out eccentrically and pressed onto the crank, which is also turned, in a manner that is in itself novel as well as extremely important. These plates not only serve as counterbalances, but also, owing to their great mass, aid in receiving and absorbing the shocks at a point where they would otherwise be transmitted directly into the bed, besides serving in the capacity of balance wheels.

The cross heads are of steel, with either babbitt metal or bronze bearing surfaces. The guides are of the locomotive type and adjustable for wear. The connecting rod is of either forged iron or steel, with straps covering the entire length of wrists. The heads of the rod are milled out in a way that obtains lightness without loss of strength. The means for taking up wear is a new and efficient arrangement. The main bearing boxes are independent of the bed, fitted into recesses, with planed and scraped surfaces. They are adjustable both ways in the direction of wear. The longitudinal adjustment is effected by a taper wedge fitted over its entire length and operated from the top.

The system of lubrication employed is very satisfactory. The longitudinal and end surfaces of the cylinder are well insulated.

The side crank engines are mounted on a tangye bed, which is designed to effectually resist the strains and absorb the vibrations incident to hard work. The main bearing is large and strong, having an angle cap which is easily and quickly removed, thus exposing in the most accessible manner the whole journalled portion of the shaft. The crank is very heavy and cast of strong close iron and balanced. The crank and cross-head pins are of forged steel, and the connecting rod is made of the same material and finely finished.

The tandem and cross-compound engines are mounted on either the side or centre crank frames. The low pressure cylinder is placed next to the bed and the high pressure cylinder is attached to it by a distance piece of such design and arrangement as to permit of the ready removal of both pistons without detaching the high-pressure cylinder. The same company also manufactures condensers and coolers.

A New Waterproof Bracket.

The accompanying illustration represents a new form of waterproof bracket recently patented by Herman Noreck, Charlottesville, Va. The bracket consists of a tubular section having an exterior screw-threaded neck surrounded by an overlapping guard. A suitably formed bell-shaped section is screwed into this and serves as a receptacle for the lamp. With this device any style of socket may be used for installing lamps, and it is especially adapted for outdoor work since it is perfectly waterproof and effectually prevents the entrance of any moisture whatever. The bracket, we are informed, has been given a thorough test and is pronounced very efficient.

Waterproof Lamp Bracket.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, August 2, 1897.

ELECTRICAL STOCKS.—There was a marked improvement in this class of securities during the past week and the market was notably stronger. All quotations show substantial gains over the previous ones, and activity seems to have been general. Chicago Edison, after a long period of inactivity, showed some vitality, a new quotation being established. New York Edison is 2¼ points higher, 883 shares having changed hands during the week. Brooklyn Edison is 4 points higher; Electric Storage Battery common is also 4 points higher, and the preferred stock advanced 4¾. General Electric was active, the total sales for the week amounting to 26,858 shares. The net advance in price on the week's business is 1¾ points. Westinghouse is somewhat higher in the Boston market.

TELEGRAPH AND TELEPHONES.—There is no great change observable in this list of securities, although the market as a whole gives indications of a stronger tone. Bell Telephone is 2 points higher than our last quotation, and Erie Telephone advanced a like amount. Western Union shows a net advance of ⅛ on the week's transactions, the number of shares sold being 24,557. The exception to the list was American District Telegraph, which lost 12½ points. The cause of this drop is not apparent.

ELECTRIC TRACTIONS.—This market was quiet, little being done excepting in Brooklyn Rapid Transit securities. Quotations remain practically unchanged. Brooklyn Rapid Transit was depressed by rumors regarding the proposed consolidation of the Brooklyn Heights and the Brooklyn Elevated roads, but when these reports (which were to the effect that negotiations had been broken off) were denied, the stock again advanced, and closed with a net loss of 1⅜ points. The total number of sales of this stock was 28,745.

INCREASED ITS CAPITAL STOCK.—The Buffalo General Electric Company of Buffalo, N. Y., has filed papers with the Secretary of State at Albany, certifying to an increase of capital stock of the company from $1,900,000 to $2,400,000. The liabilities of the company, irrespective of its capital stock and interest due on bonds, are $10,808.26.

	Par.	Bid.	Asked
ELECTRICAL STOCKS.			
Chicago Edison Company	100	120½	..
Edison Electric Ill., New York	100	121½	123
Edison Electric Ill., Brooklyn	100	111	..
Edison Electric Ill., Boston	100	147	148
Edison Electric Ill , Philadelphia	100	..	..
Edison Ore Milling	100	7½	10
Electric Storage Co., Philadelphia	100	26⅞	27
Electric Storage, pref	100	29¾	30½
General Electric	100	35	35½
General Electric, pref.	100	75	78
Westinghouse Consolidated, com	50	..	22
Westinghouse Consolidated, pref.	50	50	..
BONDS.			
Edison Electric Ill., New York, con. 5s	105	112	..
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	..	100
TELEGRAPH AND TELEPHONE.			
American Bell Telephone	100	229	230
American District Telegraph	100	..	27
American Telegraph and Cable	100	..	92
Central and South American Telegraph	100	124	127
Commercial Cables	100	170	..
Erie Telephone	100	67	68
New England Telephone	100	104½	105½
Postal Telegraph Cable	100	99	101
Western Union Telegraph	100	85⅞	86⅛
ELECTRIC TRACTION STOCKS.			
Baltimore Traction	25	18⅛	18⅜
Brooklyn Rapid Transit	..	33	33¼
Brooklyn Traction	100	..	14
Brooklyn Traction pref	100	46	48
Buffalo Street Railway	100	70	73
Cleveland Electric Railway	100	..	..
Columbus Street Railway	100	39	42
Hestonville	100	49¾	50
Hestonville, pref.	..	..	62½
New Orleans Traction	100	5	7
New Orleans Traction, pref	100	25	35
North Shore Traction	100	21	25
North Shore Traction, pref.	100	78	80
Rochester Street Railway	..	9	11
Steinway Railway	..	45	50
Union Railway (Huckleberry)	..	..	103
Union Traction, rcts $10 pd	..	12¾	13
West End, Boston	100	92½	93
West End, Boston, pref.	100	98	100
Worcester Traction	100	14	16
Worcester Traction, pref.	100	90	93
BONDS.			
Brooklyn Rapid Transit 5s, 1945	100	83⅜	..
*Buffalo Street Railway 1st con. 5s	100	109	111
Cleveland Electric Railway 1st mtge., 5s	100	102	104
*Columbus Street Railway 1st 5s	100	90	95
Rochester Street Railway 1st 5s	100	..	90
Union Railway (Huckleberry) 1st mtge. 5s	..	106	108
*Westchester Electric 1st mtge. 5s	100	100	103

*With accrued interest

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, August 5, 1897.

MR. J. B. ALLFREE, of the J. B. Allfree Manufacturing Company, Indianapolis, Ind., was in New York a few days this week, looking after the Eastern interests of the company. Mr. Allfree anticipates excellent business during the fall and early winter.

MR. C. A. CHUTE, of the G. F. Brunt Porcelain Works, East Liverpool, Ohio, was in town this week. He reports an extensive demand for his company's goods. Before returning to East Liverpool Mr. Chute will not only visit the New England States, but will also tour through Canada.

THE BROOKLYN ELECTRIC FOUNTAIN.—The electrical fountain in front of the Soldiers' and Sailors' Memorial Arch, Brooklyn, is almost completed. The fountain was designed by Mr. F. W. Darlington, of Philadelphia, and constructed by the Wilson & Baillie Manufacturing Company, Brooklyn. The basin, which is 360 feet in circumference, will be supplied by a neighboring high-pressure service tower. The Brooklyn Heights and Nassau Electric Railways will furnish the necessary power to drive the pumps.

THE UNDERGROUND TROLLEY QUESTION.—A meeting of the State Railroad Commission will be held at the City Hall, in this city, on August 11. Among the hearings on application that have been set for that date are that of the Second Avenue Railway Company, for permission to introduce an underground electric trolley system, and the Forty-second Street, Manhattanville & St. Nicholas Avenue Railway Company will also ask permission for a similar purpose. General Collis, Commissioner of Public Works, has given permission to the Metropolitan Street Railway Company to change the motive power of the Fourth Avenue surface road from horses to electricity, from the southern end of Centre Street to the extreme northern end of the line in Harlem. The decision on the application to continue the electric power from the southern end of Centre Street to the terminus of the road on Broadway has been reserved until the protest of the Third Avenue Cable Road has received further consideration.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., August 2, 1897.

MR. R. S. HALE, of this city, well known to the electrical fraternity, has the sympathy of his friends in the recent loss of his father, by death, at Bar Harbor, Me.

ANNUAL CLAM DINNER.—The nineteenth annual Rhode Island clam dinner tendered to the electrical fraternity, by Mr. Eugene F. Phillips, president of the American Electrical Works, Providence, R. I., will take place at Pomham Club, near Providence, on Saturday, August 21.

PITTSBURG NOTES.

PITTSBURG, Pa., August 2, 1897.

TROUBLE NOT SETTLED YET.—The differences between the Consolidated Traction Company and the Borough Council of Wilkinsburg have not yet been settled. Two weeks ago the possibility of an agreement being reached seemed so remote that the Council adopted a resolution instructing the Traction Company to remove all its rolling stock and other property

from the borough within five days after the adoption of the resolution. The company secured a preliminary injunction, which was afterward continued until further notice from the court, restraining the authorities from interfering with the company's property. In the meantime conferences are being held, and the residents of Wilkinsburg have hopes that some arrangement may soon be made that will enable them to travel to and from the city without a transfer, and for a single fare.

Chicago Notes.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., August 2, 1897.

MR. WILLIAM M. PORTER, sales agent for the Triumph Electric Company, Cincinnati, Ohio, last week paid a visit to the Chicago office of THE ELECTRICAL WORLD. He reports business to be decidedly improved, and says if all the inquiries materialize it will keep his company's factory busy night and day.

ELECTRIC VEHICLES.—Since its organization the American Electric Vehicle Company, of this city, has filled a number of orders for electrically propelled vehicles, among which may be mentioned an electric brake for Montgomery, Ward & Co. This vehicle is now and has been in daily use for over a year. A number of carriages of different styles are now being constructed by the company, which will soon be in practical operation. These vehicles are of handsome design and of light construction, the latter feature being rendered possible by the use of the company's improved type of accumulator.

ASSIGNMENT OF A PROMINENT ELECTRICAL SUPPLY HOUSE.—The Metropolitan Electric Company, Chicago, which has been in business since 1892, confessed judgment on July 27, for amounts agggregating $34,773. The value of stock and book accounts is estimated at $100,000. The Chicago Title & Trust Company is named as the assignee, Judgments were obtained by Mr. William H. McKinlock, president of the company, and the American Exchange National Bank, the amounts being $27,722 and $7050, respectively. The company was capitalized at $300,000, and the largest stockholders were Mr. W. H. McKinlock, president, and Walter C. McKinlock, secretary. Mr. W. C. McKinlock stated that the cause of the failure was the company's inability to obtain funds to renew the notes on which the judgments were entered. Mr. W. H. McKinlock has been in the electrical business since 1888, and is a man of large experience. In 1893 and 1894 the concern did a business that placed it among the leading firms in the West, but since December last the company, it is stated, was unable to collect enough money to meet its ordinary expenses.

RENEWING OLD STORAGE BATTERIES.—About ten years ago the New York Accumulator Company installed for Mr. Potter Palmer, at Chicago, Ill., a plant of 226 cells of storage battery, 112 cells being at the family residence on Lake Shore Drive and 114 cells at the Palmer House. The cells were rated at 250-ampere-hours capacity. This plant is believed to be the oldest storage battery plant in America. Eight months ago fifty-eight cells were removed and were replaced by new ones. The small amount of active material left in the positive plates of the old cells was removed, and after the plates had been subjected to a heavy pressure they were repasted. The negative plates were found to be in excellent condition, requiring very little treatment. Before being reassembled, each positive plate was wrapped in a single sheet of improved insulation, made of gray cardboard, electro-chemically treated. This insulation, which is prepared by a secret process, under the personal supervision of Mr. J. E. Haschke, has been handled for the last four years by the Haschke Storage Battery Company. The Palmer House battery plant is in excellent condition, and carries the load from 12 P. M. to 7 A. M., varying from 25 to 135 amperes, with a drop of only two volts. On January last Messrs. Roth Brothers & Co., Chicago, were appointed sole manufacturers, and continue to furnish the Haschke battery. Mr. Haschke is now devoting his attention to laboratory work, and will furnish this insulating material only to those using his own type of cell, or those cells manufactured by concerns no longer in existence.

Pacific Coast Notes.

SAN FRANCISCO, Cal., July 28, 1897.

MR. JOHN MARTIN, Pacific Coast district agent of the Stanley Electric Manufacturing Company, Pittsfield, Mass., recently left for a visit to the Atlantic Coast.

ELECTRICITY AT KLONDYKE.—The Westinghouse Electric & Manufacturing Company, through its Pacific Coast district agency, recently shipped the first dynamo into the famous Klondyke mining district in Alaska. It is for an alternating plant.

INCORPORATED.—The Palos Verdes Company, Los Angeles, Cal., has been incorporated, with the objects of generating electricity, dealing in franchises, engaging in electric construction, etc., by J. Bixby, G. H. Bixby, R. H. F. Variel and others, The capitalization is $400,000.

GIFT OF AN ELECTRIC LIGHT PLANT.—Eastern capitalists have offered to construct an electric lighting plant to supply the city of Spokane, Wash., with the same number of electric lights that it now uses, at the present rate, and to make a gift of the plant to the taxpayers at the expiration of ten years.

INDEPENDENT TELEPHONE SYSTEM.—Messrs. Haslacher & Kahn have installed a telephone system connecting the city of Stockton, Cal., with Occidental and Warner stations, on the Sierra railway line; with Escalon, Wilbur and Clauston on the San Joaquin Valley Railroad; with Waterford, Hickman and Monpelier on the Oakdale & Merced; and with Oakdale and Modesto.

UNFOUNDED REPORT.—The extravagant report of a local newspaper regarding the establishing of a great electric transmission system, which would utilize the waters of Clear Lake, Cal., for power purposes and be backed by the Westinghouse Company, is discredited by the local representative of the company. Conflicting interests of the many landholders on the shores of the lake has prevented the use of water.

ELECTRIC POWER FRANCHISE GRANTED.—The Blue Lakes Water Company has received a franchise to construct and operate an electric power system, which will supply electricity for various uses in the town of Jackson, Cal. The generators and water wheels are in readiness for operation at the company's large power station, and the plant will be started as soon as the transformers are installed. Two-thousand-volt current, only, can be supplied now.

TELEPHONE EXTENSIONS AND IMPROVEMENTS.—The Sunset Telephone & Telegraph Company is building the following named lines in California: From Guerneville to Fort Bragg, 112 miles; San Mateo to Pescadero; Smartsville to Quincy, 112 miles, The Pacific Telephone & Telegraph Company is rapidly extending its system of underground mains, of which about 20 miles are in use in San Francisco. President John I. Sabin has informed Mayor Phelan that he has commenced removing telephone poles on Market Street, and will substitute underground conduits in conformity with his recent request that companies using electricity do away with pole lines in the downtown distrcits. Three-inch ducts manufactured by the Fibre Conduit Company, Orangeburg, N. Y., are being laid at present, each cable containing about 200 wires.

Canadian Notes.

OTTAWA, Ont., August 2, 1897.

SMOKE NUISANCE IN TORONTO.—The city of Toronto has recently complained to the electric light company regarding the nuisance caused by smoke from the company's works, in consequence of which the company is now considering plans from several parties of smoke-consuming appliances, and will upon selection at once put in the method adopted.

READY FOR THE CONSTRUCTION WORK.—The contracts for the plant in connection with the Sherbrook Street Railway, have been about all let. The specifications for the cars call for the very latest improvements. The old-fashioned way of heating is discarded and that of electricity substituted. There will be two motors on each car, with a nominal power of 70 horse, and which can be worked separately or conjointly. The work on the power house is being rapidly pushed, and every effort is being made to have construction work completed at the earliest possible moment.

TO SUPPLY ELECTRIC HEAT.—A new company has been organized in this city, called the "Dominion Electric Heating & Supply Company," and will commence operations very shortly. The stockholders held a meeting on July 31, and elected officers. Mr. Andrew Holland is president and J. I. MacCracken, secretary-treasurer. The object of the company is to supply electric heat at a much lower figure than the present rate. The company intends to commence by supplying heat for domestic utensils, such as flat-irons, cooking appliances, etc., and gradually extend to car-heating, and in the end to house-heating. The process is secret, and no details can be obtained. The intention of the company is to establish workshops here on a small scale, and, if the results warrant, to extend them very considerably and build a large factory.

General News.

New Incorporations.

THE ILLINOIS TELEPHONE COMPANY, Bluffs, Ill., has been incorporated, with a capital stock of $5000. Those interested are F. C. Funk, R. F. Wassen and C. F. Tonn.

THE JANESVILLE ELECTRIC LIGHT & POWER COMPANY, Janesville, Wis., has been formed with a capital stock of $25,000. The officers of the new company are: President, Charles B. Conrad; secretary and treasurer, Charles F. Lowing, Chicago.

THE FOX RIVER VALLEY ELECTRIC RAILWAY COMPANY, Milwaukee, Wis., has been incorporated, with a capital stock of $200,000. Those interested are Henry D. Smith, Frank G. Bigelow, Henry C. Payne, Charles F. Pfister and Benjamin K. Miller, Jr.

THE OAK HILL TRACTION COMPANY has been incorporated at Albany, N. Y., to construct a road 20 miles long from the above terminus to Oak Hill, Conesville, Cooksburg, Rensselaerville, East Durham and Cairo, in Greene County. Capital stock, $250,000.

THE EASTERN ENGINEERING COMPANY, of New York City, N. Y., has been formed for the purpose of carrying on a general mechanical and electrical engineering business. Among those interested are Franklin R. Haines, Sewell T. Tyng and Francis N. Tyng. Capital stock, $5000.

THE CITIZENS ELECTRIC LIGHT & POWER COMPANY, Middletown, N. Y., has been incorporated by J. E. Iseman, Thomas H. Desmond, R. H. Houston, T. E. Hayes, G. G. Otis, F. S. Rogers, H. C. McBriar, R. C. Tuthill, G. H. Iseman, Clarence Abrams and Louis Wolff.

THE COXSACKIE & GREENVILLE TRACTION COMPANY has been incorporated at Albany, N. Y., to operate a road from the terminus of the Greene County Traction Company's line in Coxsackie to Greenville and Durham, a distance of 12 miles. The capital stock is $150,000.

THE PAULDING ELECTRIC LIGHT & POWER COMPANY, Paulding, Ohio, has been organized to furnish light, heat and power for the village of Paulding. The incorporators are Charles H. Peters, Charles M. Lott, Conrad N. Rumpel, George W. Lott, and J. Caroll Heaton. Capital stock, $15,000.

THE MIDDLEBURG & OAK HILL TRACTION COMPANY has filed articles of incorporation with the Secretary of State at Albany, to connect with

the Oak Hill Traction Company's line near Rensselaerville, and running through Broome and Middleburg, a distance of 25 miles. The capital stock is $300,000.

THE MANDRAKE, WILMINGTON & MORRIS ELECTRIC RAILWAY COMPANY has been organized at Joliet Ill., to run a line from Mankakoo through Wilmington, and thence to Morris. The capital stock is $50,000, and the directors are Thomas J. Diven, August Enrich, Cyrus L. Bennett and Philip I. Cromwell.

THE PULLEN BATTERY & ELECTRICAL MANUFACTURING COMpany, Philadelphia, Pa., has been incorporated for the purpose of manufacturing reversible primary batteries and all kinds of electrical appliances. The capital stock of the company is $100,000, and the incorporators are Leon W. Pullen, J. Madison Pullen, of Camden, and Charles L. Klauder and A. E. Bainbridge, of Philadelphia,

THE CARACAS ELECTRIC LIGHT, HEAT & POWER COMPANY has been incorporated at Trenton, N. J., with a capital stock of $1,000,000. The company will build and operate electric plants and a railroad in Venezuela and other South American countries. John E. McEwan, of Brooklyn, Charles C. Drew, of New Brighton, S. I., and Robert Weinmann, of Jersey City, are the incorporators.

THE WINDHAM TRACTION COMPANY has been incorporated at Albany, N. Y., to construct a road connecting with the Oak Hill Traction Company's line near Durham, thence to run to Conesville, Manor Hill, the towns of Windham and Ashland, and the villages of Harrisonville and East Windham, a distance of 20 miles. Capital stock, $250,000. The directors are W. G. Raines, T. E. Smith, W. F. Leland, W. S. Smith, M. E. Ingersoll, P. Anderson, E. Richter and Albert A. Lasson, of New York City, and George C. Spencer, of Chicago. The principal office of these companies will be in New York City.

THE TELEGRAPH AND TELEPHONE.

GIBSON, ILL.—Work on the telephone line between Gibson and Sibley has been commenced.

SAGUACHE, COL.—Saguache is now connected by telephone with the telegraph station at Moffet on the Denver & Rio Grande Railway.

LORAIN, OHIO.—Arrangements have been consummated whereby the Black River Telephone Company's exchange in this city will be connected with the Cleveland telephone exchange.

MINNEAPOLIS, MINN.—The Northwestern Telephone Exchange Company has purchased the building at Third Avenue, South and Fifth Street, and is remodeling the structure for its own purposes.

DANVILLE, KY.—The East Tennessee Telephone Company is preparing to extend its metallic circuit from Louisville to Danville via Frankfort and Lawrenceburg, which will put this city in long distance communication with Louisville and the other important cities of the country. The line will also be extended to Stanford, which is at present off the main line.

OLEAN, N. Y.—The office of the Western Union Telegraph Company in this city was badly damaged by fire on July 23. The total loss was about $7000. It is supposed that one of the wires became crossed with an electric light wire, thus setting fire to the switchboard. The telegraph office was completely gutted, but the fire was confined to the one room.

CONNEAUT, OHIO.—The construction men of the telephone company have commenced work on the new exchange at Jefferson and expect to have the same completed in about a month. The Ashtabula independent exchange has already 250 subscribers, and arrangements have been made to connect with the Madison company's line, which will enable them to work in connection with all the other independent lines in this and adjoining counties. The Conneaut Company will very soon begin the construction of a line to Ashtabula.

BUFFALO, N. Y.—Manager Tillinghast, of the Western Union Telegraph Company in this city, has received notice from United States Attorney-General McKenna, that he must discontinue the delivery in this city of mail, bills and circulars for business firms. It has been the practice of the Western Union Company to deliver for business firms, at the rate of 1 cent a letter, all their mail. This cut down the revenue of the Post Office and the matter was referred to the Attorney-General, the complaint being that the telegraph company was infringing upon the rightful business of the Government postal service. Manager Tillinghast discontinued the service as requested.

ELECTRIC LIGHT AND POWER.

MINERVA, OHIO.—A municipal electric light plant is being built in this city.

BURLINGTON, VT.—A village meeting is called to decide upon and to appropriate funds for an electric light plant.

HOUSTON, TEX.—The Council has under consideration the issue of $100,000 in bonds to put in an electric light plant.

ELMORE, OHIO.—The Council has decreed that an election take place on August 16 to vote on the electric light question.

MANITOWOC, WIS.—The Manitowoc Electric Light Company has enlarged its plant and put in another large Corliss engine.

MECHANCISBURG, PA.—Mechanicsburg and Shippensburg are agitating the question of municipal ownership of electric light plants.

ALMA, WIS.—Preparations have been completed for lighting the town by electricity, and a 350-hp generating plant is being constructed.

DETROIT, MICH.—The Council at Armada has awarded the contract to O. Drake & Sons to light the village by electricity for five years.

ABERDEEN, MISS.—The electric light plant in this place was burned recently entailing a loss of $15,000. The insurance was only $2000.

PHILADELPHIA, PA.—The new plant of the Lancaster Electric Light Company has been put in operation, and is working successfully.

MONROEVILLE, OHIO.—An election has been called for August 17, to vote on the question of issuing $18,000 water and $8,500 electric light bonds.

BRADDOCK, PA.—Estimates for the erection of an electric light plant are wanted by the engineer at Braddock, Pa., for the North Braddock borough.

BANGOR, ME.—The Skowhegan Electric Light & Power Company has placed a contract for a $10,000 power station, to be built upon the Levi Weston property.

ALTON, ILL.—On account of the coal famine electric light in this city will be extinguished at midnight until the strike is settled and coal is more plentiful.

CARLISLE, PA.—The people of Shippensburg will vote on the question of increasing their borough debt $10,000 for the purpose of establishing an electric light plant.

PHILADELPHIA, PA.—General Contractor E. M. Holliday, of Listerville, Pa., has been awarded the contract for an electric light plant that is to be built at that place at a cost of about $5000.

HENDERSON, MINN.—An election will soon be held here to determine the question as to whether the town shall issue $5000 in bonds for the purpose of buying an electric light plant.

JACKSONVILLE, TEX.—Jacksonville now has electric light, which was turned on last week for the first time. It is giving entire satisfaction, and the jump from coal oil to electric light is very marked and satisfactory.

TUNKHANNOCK, PA.—The Town Council has granted a franchise to the Tunkhannock Electric Light, Heat & Power Co. The main business streets will be lighted with arc lights and a few incandescent lights will be provided for residence streets.

WASHINGTON, D. C.—Mr. W. C. Lyon, of this city, is preparing plans and specifications for a water works, sewerage system and an electric plant in the town of Hyattsville, Md. He wishes to communicate with manufacturers and dealers in machinery and supplies in these lines. His address is care Superintendent, Architect's Office, Treasury Department.

WOODSTOWN, PA.—A party of capitalists has been here in consultation with the borough authorities in reference to lighting the town with electricity. The proposition is that ground shall be donated for the location of a power house and the right of way given for the placing of poles and wires for lighting stores and residences, and the company will light the town free.

NEW RICHMOND, WIS.—Plans have been received by the president of the new Apple River Power Company for the new power plant on the Apple River, eight miles from this city. Power is to be transmitted electrically to this city and will be utilized for the water works and electric lighting, also for manufacturing purposes. About 2000 horse-power will be available.

WILKESBARRE, PA.—Messrs. Shepherd & Rust, electrical contractors, of this city, are receiving bids on a generating plant to be installed in a new hotel now in the process of construction here, and which is said to be the largest and finest in Northeastern Pennsylvania. The equipment will consist of two direct-connected generators of 100 and 75-kw capacity, respectively.

GRANT'S PASS, ORE.—On July 20, the business portion of this city was destroyed by fire. The plant of the Grant's Pass Water, Light & Power Company was totally consumed and the citizens have been compelled to use kerosene for lighting purposes until the electric plant is rebuilt . The loss of the building and damage to machinery will amount to about $15,000. The company will rebuild at once.

THE ELECTRIC RAILWAY.

BALTIMORE, MD.—A new electric line is being contemplated, to run along Charles Street Avenue.

WEST CHESTER, PA.—It is announced that the Philadelphia & West Chester trolley road will be extended to West Chester very soon.

SCRANTON, PA.—The ordinance granting permission to the Scranton Traction Company to extend its tracks on certain streets of West Scranton passed final reading.

BEAVER FALLS, Pa.—At Beaver Falls the contract has been let for the construction of a new electric railway, to be 2 miles in length, and to be completed in forty-five days.

ESSEX, MASS.—It is stated on good authority that President Ferguson, of the Gloucester, Essex & Beverly Street Railway Company, is planning to build a branch railroad from Essex to Manchester.

CHAUTAUQUA, N. Y.—A certificate was granted to the Westfield, Mayville & Chautauqua Railroad Company to construct a road to be operated by storage battery power between Mayville and Chautauqua.

SOUTH BETHLEHEM, PA.—The route for the proposed new trolley line from South Bethlehem to Hellertown has been decided upon. Pascoe & Crilley, the builders, will begin work upon the road within a few weeks.

McKEESPORT, PA.—An electric road is to be constructed between Irwin and McKeesport, Pa., a distance of about 25 miles. Mr. W. F. Sadler, Jr., manager of this road, wants bids from contractors at Greensburg, Pa.

GLASSBORO, N. J.—Efforts to secure the extension of the Camden, Gloucester & Woodbury Railway, from the present terminus of the road at Mantua to this place and Pitman Grove have again been revived, and negotiations have again been resumed with the turnpike company for the right of way.

LEGAL NOTES.

PLANT FORECLOSED.—The mortgage bondholders of the Edison Illuminating Company, of St. Louis, have foreclosed on the plant and property of

that concern, and it will be sold at foreclosure sale September 11. The property is to be disposed of to satisfy the unpaid interest of $4,000,000 on 6 per cent. bonds. The sale is to be made by virtue of a deed of trust given by the company to the Knickerbocker Trust Company of New York.

ELECTRICAL SWITCH DECISION.—Judge Lacombe, in the United States Circuit Court, New York, handed down a decree on July 28, in the action of the Bryant Electric Company against the Cutter Electrical & Manufacturing Company and Charles D. Doubleday, declaring the patent No. 391,512, granted October 23, 1888, to William B. Cleveland, for an improvement in electrical switches, good and valid, and perpetually enjoins the defendants from selling or using the invention described in the patent.

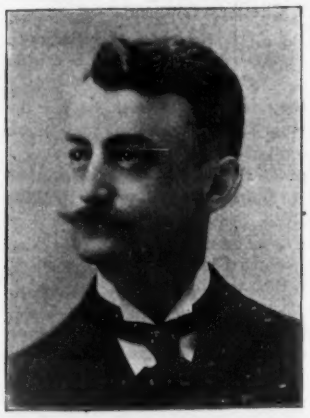
TEMPERATURE-REGULATING SWITCH.—The United States Circuit Court of Appeals for the Second Circuit, on July 22, rendered a decision reversing the decree of the Circuit Court, which had granted to the Dewey Electric Heating Company an injunction against the Albany Railway Company to prevent the use of the Consolidated Car Heating Company's temperature-regulating switch in connection with an indicating device, as being an infringement of the ninth claim of the Dewey patent, No. 464,247. The court holds that this claim is entirely void for want of patentable invention, and this decision, we are informed, finally settles the right of the Consolidated Car Heating Company and its customers to use its temperature-regulating switches with indicators, as the same have been and are now constructed.

THE CARBORUNDUM CASE.—In the last issue of The Electrical World brief mention was made of the decision, by Judge Buffington, in the United States Circuit Court, Western District of Pennsylvania, in the case of the Electric Smelting & Aluminum Company vs. the Carborundum Company, in favor of the defendant. We have since that time received a copy of Judge Buffington's opinion in full. The Electric Smelting & Aluminum Company filed this bill against the Carborundum Company, alleging infringement of three patents owned by the complainant company. At the hearing the infringement of patent No. 335,058, granted January 26, 1886, to Alfred H. Cowles was not pressed, but was of all claims of patent No. 319,795, issued June 9, 1885, to Eugene H. Cowles, et al., for a process of smelting ores by the electric current, and of patent No. 319,945, issued June 9, 1895, to Eugene H. Cowles, et al., for an electric smelting furnace. The opinion is quite lengthy, and the judge orders the dismissal of the complainant's bill for the reason that infringement has not been shown.

ELECTRIC RAILWAYS ON PUBLIC ROADS.—Judge Neilan, at Hamilton, Ohio, on July 20, rendered a decision in the case of August Dietz vs. the Cincinnati & Miami Valley Traction Company, and the County Commissioners, involving the question of authority of granting an absolute right of way by County Commissioners to a street railway or railroad in the State of Ohio, for the carrying of passengers, freight, mail and express. This action was for an injunction to prevent the Traction Company from building its railway on and along certain public roads of the county as authorized by the Board of Commissioners. After reviewing the case at considerable length, and discussing the law bearing on the point at issue, Judge Neilau orders that the temporary injunction heretofore allowed be vacated and dissolved, and the petition dismissed. This case is regarded as of great importance to contractors and security holders, for the reason that the question has never before been decided by a court. It is stated that the Cincinnati, Hamilton & Dayton Railway Company was the real plaintiff in the action.

Personal Notes.

MR. SHELDON CARY has just been elected secretary of the Buckeye Electric Company, Cleveland, Ohio. Mr. Cary has been connected with this company for many years in another capacity, and his promotion is a gratifying evidence of the esteem in which he is held by his associates.



Charles E. Corrigan.

MR. CHARLES E. CORRIGAN, the subject of this sketch, is one of Chicago's enterprising young business men. He was born in Martinsburgh, Lewis County, N. Y., in 1863; emigrated West while in his teens, and was for a time engaged in the wholesale seed business in Minneapolis, Minn. The concentration of trade at Chicago just prior to the World's Fair, however, caused him to dispose of his interests in the seed business and embark in business in Chicago. He always had great faith in the future of electricity as a motive power, and at once turned his attention in that direction. After considerable research and investigation he determined to develop the application of electricity as the motive power in the propulsion of vehicles. He associated with himself some of the best engineering talent to be procured in this country and Europe, and after nearly four years of experimenting produced a practical vehicle, which is admired by all who have seen its performance, and is a monument to his enterprise and perseverance. In March, 1896, he organized the American Electric Vehicle Company, with a capitalization of $250,000, of which company he is the general manager. The company has a large factory about completed at New Chicago, a suburb of Chicago, in which it will manufacture its product complete. Mr. Corrigan is to be congratulated on his perspicacity in selecting so promising a field for the application of his business energy, and no doubt he will achieve abundant success for his company and himself.

Trade and Industrial Notes.

PHOSPHOR-BRONZE.—The Phosphor-Bronze Smelting Company, Limited, Philadelphia, Pa., has just issued a revised phosphor-bronze price list.

ENGINES FOR A DRY-GOODS HOUSE.—The Ball & Wood Company, New York, is preparing to install a 235-hp direct-connected engine, and a 150-hp direct-connected engine in the power plant of the well-known dry-goods house of James A. Hearn & Son, New York City.

LEAD PAINTS.—The merits of lead paints and silica-graphite paints are compared in a neat pamphlet just issued by the Joseph Dixon Crucible Company, Jersey City, N. J. Those interested in the subject of protective coverings for iron structural work will gain considerable interesting and valuable information by a careful perusal of this pamphlet.

"A GREAT SOURCE OF SUPPLY."—The Western Electric Company, New York and Chicago, has issued a card containing a very handsome halftone illustration of Niagara Falls. The picture is entitled "A Great Source of Supply," and underneath are the company's name and addresses, leaving the observer to decide for himself which object the title fits best.

X-RAY SUPPLIES.—The Swett & Lewis Company, Boston, Mass., in a little catalogue just issued, illustrates the various X-ray appliances manufactured and dealt in by this company. These include Stanley's Toepler-Holtz machines, Crookes tubes of various designs, Ruhmkorff coils, fluoroscopes, Geissler's tubes, etc. The catalogue also gives directions for setting up and operating X-ray outfits.

REORGANIZATION OF A BOILER BUSINESS.—The Fulton Steam Boiler Works, Richmond, Ind., has succeeded to the business recently carried on by John T. Caulfield. Mr. Caulfield has been elected president of the company and Mr. Thomas R. McDonnell has been chosen treasurer. The capital is $85,000. The new company will construct steam boilers and carry on the foundry business of the old concern.

LIGHTING FIXTURES IN AN ART GALLERY.—The electric and gas lighting fixtures in the Corcoran Gallery of Art, Washington, D. C., were installed by I. P. Frink, New York. In a letter concerning these fixtures, from Mr. F. S. Barbarin, curator of the gallery, that gentleman states that the lighting of all the rooms, particularly the picture galleries by the Frink system of reflectors has given entire satisfaction.

ENCLOSED ARCS IN AN ARMORY.—The Electric Arc Light Company, New York, manufacturer of the "Pioneer" 150-hour enclosed arc lamp, continues to report booking satisfactory orders, a very large one of which is for the installation at the Seventh Regiment Armory in New York City. This contract was awarded, we are informed, after a very severe test, the "Pioneer" being acknowledged as being entitled to carry off the honors.

DROP-FORGINGS.—The Keystone Drop-Forge Company, Philadelphia, Pa., announces that it has purchased the entire plant and all its appurtenances of the old Philadelphia Drop-Forge Company, and is now prepared to receive orders for standard and special drop-forgings. Concurrent with this announcement the Keystone Company issued an illustrated catalogue and price list of its products, which embrace drop-forgings of every description in iron, steel, copper and bronze.

A NEW WAY TO MAKE MONEY DISAPPEAR.—The Pacific Electric Company, La Crosse, Wis., has obtained possession of a very clever device called the "electrical trick," by which a piece of money can be made to disappear in the most mysterious manner, defying detection by the cleverest persons. The company has it to advertise its shade lamps and dental lamps, and will be pleased to send one to any person writing for one and enclosing 4 cents in stamps to cover the cost of mailing.

THE NEW AMERICAN TURBINE.—In a well-illustrated catalogue just issued by the Dayton Globe Iron Works Company, Dayton, Ohio, various types and sizes of the New American Turbine are shown, together with tabulated reports of tests made upon various wheels of this particular make. Among the points of superiority claimed for these wheels are: Highest average efficiency from whole to half water, steadiness of motion, easy regulation by governor and economy of water. The catalogue describes and illustrates the large water power plant at Great Falls, Mont., where are installed several large American turbines. This mining plant is a notable one on account of its great size.

UP-TO-DATE PLANT.—The Davis & Egan Machine Tool Company, Cincinnati, Ohio, has purchased the extensive works formerly occupied by the W. S. Merrill Chemical Works, Cincinnati, Ohio. The buildings are modern and massive; adapted to the operation of heavy machinery. They are 103 feet front, five floors, with basement and sub-cellars, having a railroad frontage on two streets. The new purchasers are now making complete installations of new engines, boilers, generators, dynamos, etc., and will have, when completed, an up-to-date power plant. The new addition joins the present works of the Davis & Egan Company, the purchase being necessitated by the rapidly expanding foreign trade.

ENLARGING ITS PLANT.—The Newport News Shipbuilding & Dry Dock Company is making extensive additions to its large plant at Newport News, Va. One of these, which is now under way, is the erection of an extension to the machine shop, which will be 100 feet wide and 200 feet long. The central portion of the building will be 50 feet high, and will be supplied with an electric traveling crane capable of lifting and carrying a load of 50 tons. On either side of this central space will be located a gallery arranged for small machines and fitting tools. The building is to have a steel framework throughout, and the roof is to be covered with corrugated iron. The Berlin Iron Bridge Company, East Berlin, Conn., has the contract for furnishing and erecting the steel work of the building.

SALES OF ENGINES AND BOILERS.—The Murray Iron Works Company, Burlington, Ia., has recently made the following sales and shipments of Sioux Corliss engines and high-pressure tubular boilers: One 100-hp Corliss engine to the Lavaca Oil Company, Hallettsville, Tex.; one 75-hp Corliss

engine and one 80-hp boiler to Rockford (Iowa) Electric Light Works; one 100-hp Corliss engine to Gustav A. Baumgarten, Schulenberg, Tex.; one 150-hp Corliss and one 60-hp to Brookfield Electric Light Company, Brookfield, Mo.; one 100-hp Corliss to Shannon & Mott Co., Des Moines, Ia.; one 125-hp Corliss to the Anchor Mill Company, Cedar Rapids, Ia.; one 100-hp Corliss and two 70-hp boilers to the city of Unionville, Mo.; one 100-hp Corliss and two 100-hp boilers to the city of Rock Rapids, Ia.; one 100-hp Corliss and two 100-hp boilers to Col. J. W. Blees, Macon, Mo.; one 80-hp boiler for the Lake Mills (Iowa) Electric Light Works; two 80-hp high-pressure boilers for the Oskaloosa (Iowa) Heat, Light & Power Company. The company is building a 600-hp cross-compound, direct-connected, condensing, Sioux Corliss engine for the San Antonio (Texas) Street Railway Company.

CATALOGUE OF HEATING APPARATUS.—A catalogue out of the ordinary, in the matter of illustrations at least, has just been issued by the American Electric Heating Corporation, Boston, Mass. On the first page is a half-tone illustration of a showcase assortment, which is designed to enable dealers and lighting companies to place heating appliances before their customers in an attractive manner. The case contains very heating devices, including three stoves, irons of various kinds, stew pans, etc. Scattered through the pages of the catalogue are illustrations and descriptions of the many heating appliances made by the company, including air heaters, portable stoves, "Five-o'clock tea," stew pans, chafing dishes, irons, soldering pots, glue pots, foot warmers, car heaters, etc. The Universal field rheostat is also shown in three views, and the motor-starting rheostat recently brought out by the company is represented by an excellent half-tone illustration. On the inside of the back cover is given a view of the electric laundry of the Hospital for the Insane, at Indianapolis, Ind., and on the outside of the same is shown a view of an electric kitchen. The entire catalogue is artistic in design and attractive.

AN ARTISTIC CATALOGUE.—That catalogue-making may be made the subject for the highest artistic effort is evidenced by the new catalogue just issued by the Jandus Electric Company, Cleveland, Ohio. This production of the printer's art has for its object the description and illustration of the Jandus enclosed arc lamps for all circuits, which were formerly sold under the name of "Manhattan" lamps, and that its purpose is well accomplished is evident by a glance through its pages. Excellent half-tone illustrations are given of the various styles of lamps made by the Jandus Company, for constant potential, constant current, railroad and power circuits and alternating circuits. An illustration of the John Scott medal, awarded by the Franklin Institute to Wm. Jandus, forms a conspicuous subject on page 4. The Jandus enclosed arc lamp is comprehensively described, as to its construction and operation, and well illustrated as to details, and the report of independent tests of the Jandus lamp, which is included in the text, shows very favorable results. The reading matter is printed in emerald green, on pea-green paper—a very effective and pleasing combination of color—and the cover is of light olive color, with a scroll-work vignette in the upper right-hand corner, in which are the words, in embossed letters, "The Midnight Sun." This is one of the most attractive catalogues we have seen in some time.

A LARGE REPAIR SHOP.—With the increasing application of electrical machinery to so many branches of manufacturing, there has arisen a demand for repair shops in charge of men thoroughly familiar with the many types of electrical apparatus, where may be repaired burned-out armatures, field and transformer coils, worn commutators, etc., resulting from careless handling. The factory of Stucky & Heck, Newark, N. J., is splendidly equipped with machine tools for doing repair work, and gives employment to fifty-five men in the various departments. It occupies a three-story building, 100 x 37 feet, in close proximity to the Pennsylvania Railroad, which affords facilities for quick shipments of goods. All the heavy machinery for setting up and turning commutators, winding fields, magnets, and remodelling dynamos and motors is contained on the first floor, and comprises machine lathes, planers and shapers, beside several special winding machines. A boiler and engine in the rear furnish power to the entire building. The second floor is devoted to repairing and rewinding armatures and transformers. Circuits of different voltages, both alternating and direct current, are arranged for testing all sorts of apparatus, and in addition there is a special set of railway motor fields for testing railway armatures. The third floor contains screw machines, lathes, grinding machines, etc., and is devoted to manufacturing the many specialties produced by the company. Beside repairing and redesigning electrical apparatus, Stucky & Heck are engaged in turning out a great deal of special work. They are at presen constructing a horseless carriage.

Business Notice.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 67-71 Park Place, New York City.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JULY 27, 1897.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

586,957. BRUSH HOLDER; N. M. Beede, Schenectady, N. Y. App. filed May 5, 1897. The combination, in a brush-holder, of an opening for the reception of a commutator-brush, a brush movable in said opening, a flexible connection leading from the brush, and a spring-clamp secured to the flexible connection, and making electrical connection with the body of the brush-holder.

586,993. TELEPHONE SYSTEM; G. Dillberg and P. Rabbidge, Sydney, New South Wales. App. filed Sept. 9, 1895. In a telephone, the combination of the speaking circuit, a core, two coils thereon, the call-circuit, one of said coils being connected in the speaking-circuit and the other in the local battery, the armature of the call-circuit being arranged to be attracted by the said core to close the call-circuit, the said coils acting as an induction-coil for the speaking-circuit and as a relay for the call-circuit.

586,995. FORM FOR WINDING COILS FOR DYNAMO ELECTRIC MACHINES; H. Geisenhoner, Schenectady, N. Y. App. filed March 16, 1897. In a winding form, the combination of means for giving the coil a shape while winding that is substantially the same as that of the finished article, and means for finally shaping the coil before removing it from the form.

587,004. TELEPHONE EXCHANGE; M. G. Kellogg, Chicago, Ill. App. filed July 26, 1890. In a telephone-exchange system, multiple switchboards each divided into two sections which are distinct and placed apart from each other over different floor-space, an answering-section containing the annunciators and switches of the lines whose calls are to be answered at the board and a calling-section containing two switches on which the operator may call and connect any line which she has answered, the calling-sections each being placed end to end and the answering sections each convenient to and in front of its calling-section.

587,013. TELAUTOGRAPH; L. O. McPherson, Highland Park, Ill. App. filed Oct. 9, 1895. In a telautographic system, the combination of a mechanism for sending pulsations of successively-alternate polarity for controlling the operation of a receiving pen, a reversing mechanism, a reversing-relay in the circuit of said pulsations for controlling the operation of the reversing mechanism, the same being controlled by changes in the strength of said pulsations and means whereby the action of the reversing-relay is effected by changes in the rapidity of the succession of said pulsations.

587,015. ELECTRIC METER; G. F. Packard, Fort Wayne, Ind. App. filed May 6, 1897. The combination in an electric meter of an energizing coil or coils or field of force; a rotary armature comprising a plurality of separable radial vanes rigidly connected on their supporting shaft or spindle by a pair of recessed and slotted discs interlocking therewith, the said vanes being so arranged in inductive relation to said field as to be successively repelled therefrom, clamping-discs mounted on said shaft and having their inner faces recessed to receive interlocking lugs on said vanes and radially slotted, a speed-regulator comprising a slotted base fixed on said shaft and one or more adjustable strips arranged therein, and a counting or registering train conected with said armature.

587,024. RECTIFIER; E. Thomson, Swampscott, Mass. App. filed Oct. 31, 1896. The improvement in the art of rectifying alternating current, which consists in passing the current through a rectifying device and by external power imparting to the rectifier a tendency to rotate at a speed greater than synchronism.

587,027. LAMP SOCKET; H. C. Wirt, Schenectady, N. Y. App. filed April 30, 1897. In an incandescent lamp socket formed of a two-part shell, one part thereof being provided with L-shaped open slots; and the other with screws projecting through the said L-shaped slots; in combination with a molded base having enlarged recesses into which the ends of said screws project and have play to lock the parts together.

587,047. TROLLEY WHEEL FORK; S. B. Thompson, Baltimore, Md. App. filed Dec. 2, 1896. A trolley-wheel fork having one of the prongs or supports for the axle formed of a flat spring, the upper end of which presses against the hub of the trolley-wheel forming an electrical contact therewith and its lower end rigidly secured to the base of the fork.

587,062. ELECTRIC BELL; J. T. O'Brien, Bridgeport, Conn. App. filed April 13, 1897. The combination with a main circuit, a shunt circuit, a bell and an electromagnet in the main circuit, of an armature in the shunt-circuit carrying a striker and a contact, a pin in the shunt-circuit carrying an insulating block, and a second contact, the first contact being normally in contact with the insulating-block, but being placed in engagement with the second contact and thereby closing the shunt circuit by the movement of the armature to the magnet which is caused by the closing of the main circuit.

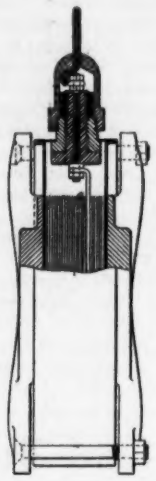
587,080. CALLING APPLIANCE FOR TELEPHONE SWITCHBOARDS; F. R. McBerty, Downer's Grove, Ill. App. filed Nov. 12, 1895. The combination with telephone lines, each provided with signaling appliances adapted for selective operation, several pairs of plugs for uniting lines, their associated plug circuits, the operator's telephone, of conductors and a group of keys each determining the transmission in the said conductors of a current adapted to operate a particular signal, and a key in each plug circuit adapted to take either of two positions, said key being adapted when in one position to break the plug circuit and to connect the telephone with one plug of the pair and the said conductors with the other plug of the pair and in its other position to complete the plug-circuit.

587,081. TELEPHONE EXCHANGE APPARATUS; F. R. McBerty, Downer's Grove, Ill. App. filed June 3, 1896. The combination with a tele-

phone line grounded at two points subject to differences of potential and provided with a generator of alternating current at one sub-station and an annunciator at the other station, of a group of polarization-cells in one of the ground branches.

587,114. ELECTRIC CONDENSER; C. S. Bradley, Avon, N. Y. App. filed Oct. 7, 1895. An electric condenser having its pile of plates inclosed in a fluid and air-tight metallic casing hermetically sealed at all joints, whereby the access of moisture in the outside air is prevented and the capacity is kept unaltered.

587,119. TELEPHONY; J. W. Gibboney, Lynn, Mass. App. filed July 26, 1895. The art of operating a telephone receiver consisting in passing through coils wound thereon, an alternating current or currents periodically changing in value and capable of producing audible vibrations in the re-



No. 587,114.—Electric Condenser.

ceiver, such current furnishing energy for operating the transmitting-circuits, modifying such current by a suitable transmitter, and neutralizing the effect of the periodic current in the receiver.

587,120. TELEPHONY; J. W. Gibboney, Lynn, Mass. App. filed Aug. 3, 1896. The improvement in the art of electrically transmitting sound waves, which consists in generating alternating currents of relatively-displaced phase, superposing upon one or more of such currents electrical undulations or vibrations corresponding to the sound-vibrations to be transmitted, and by such superposed electrical undulations or variations actuating a suitable receiver.

587,134. RAIL BOND; J. A. Mosher, Chicago, Ill. App. filed June 21, 1897. A rail bond comprising a body portion and end pieces, the body portion being looped or hooked over a projection of each of the end pieces and secured by an overturned portion of the end piece compressed upon it.

587,163. MULTIPOLAR DYNAMO ELECTRIC MACHINE; S. W. Rushmore, Brooklyn, N. Y. App. filed Feb. 23, 1897. The combination in a multipolar dynamo, of an armature and sets of brushes for separately collecting the currents generated in the parts of the armature under the different magnets, independently of the other sections, and connections from each set of brushes through the field-coil of its magnet only.

587,164. DYNAMO ELECTRIC MACHINE; S. W. Rushmore, Brooklyn, N. Y. App. filed May 14, 1897. The method of operating a dynamo having a plurality of pairs of N and S poles, which consists in collecting

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current under but one pole only of each pair, using the second pole of each pair to keep the magnetic flux of its section from flowing to other sections.

587,204. SWITCHBOARD ANNUNCIATOR; N. H. Holland, Montreal, Canada. App. filed Sept. 5, 1896. In combination with a switchboard face strip, an annunciator magnet, a retaining frame piece for said magnet, said frame-piece being grooved at right angles to the length of the magnet, and a screw adapted to take into a screw-threaded boring in said face-strip adjacent to said frame-piece and having a head with a portion thereof cut away, the remaining portion of the head being all adjustable into said groove.

587,213. CONDUIT; A. S. Krotz, Springfield, Ohio; W. P. Allen, Chicago, Ill., and O. S. Kelly, Springfield, Ohio. App. filed May 28, 1896. The combination with the track-rails, a guard rail adjacent to one of the track-rails, insulated standards or supports attached to said guard-rail, a contacting-rail secured to and supported by said standards, a shield adjacent to said contact-rail and on the opposite side of said standards from said guard-rail, and a top or cover joining said side shield and extending over the tops of said supporting standards and over said contacting rail, said top or cover being arranged in a plane above said guard-rail.

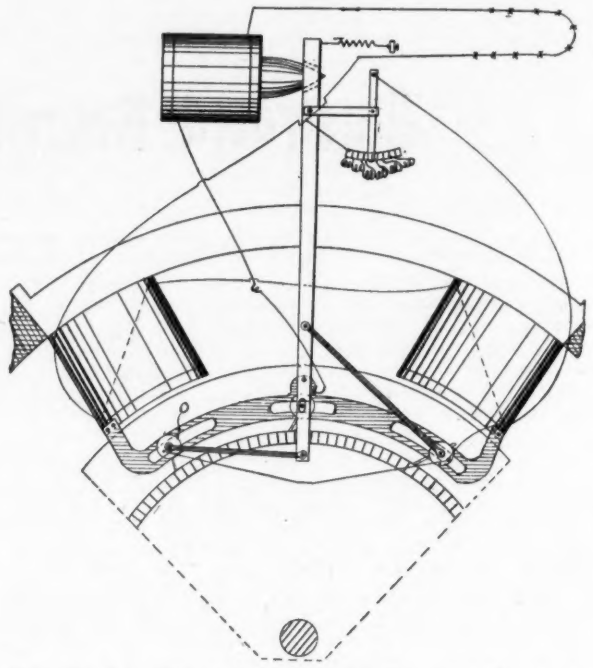
587,214. TROLLEY; A. S. Krotz, Springfield, Ohio; W. P. Allen, Chicago, Ill.; and O. S. Kelly, Springfield, Ohio. App. filed June 16, 1896. In a trolley, the combination of the base, one or more spring supports rigidly attached at one end to said base, a contact shoe supported on the free end or ends of said spring support or supports, said spring support or supports consisting of a flat sheet of elastic metal and a rigid stop adapted to limit the travel of said spring or springs.

587,216. WIRE HOLDER; J. B. Lawrence, Salem, N. J. App. filed Nov. 2, 1896. A wire holder consisting of an upright standard having feet provided with openings, upwardly projecting arms having interior screw-threads, and an exteriorly screw-threaded insulator.

587,217. FUSE HOLDER AND ELECTRIC CUT-OUT; H. A. Lewis, Norristown, Pa. App. filed Jan. 11, 1897. A device provided with a bridge formed of infusible and non-conducting plates arranged in close proximity to each other and formed in their opposite edges of non-registering slots for the entrance and exit of the fusible wire, the latter extending between the plates and in contact with the sides thereof, whereby when the wire is fused by an excessive current the portion of the wire between the plates will not be fused.

587,226. TELEPHONE TRUNK CIRCUIT; J. J. O'Connell, Chicago, Ill. App. filed Feb. 11, 1897. In a telephone system the combination of a trunk-circuit between two switchboards, an associated signal-circuit and two local circuits containing call and disconnecting signals, respectively, at each end of said trunk and signal circuits, with a polar relay in the signaling circuit at each end thereof, and switch connections in the trunk-circuit at each end thereof, the said relay and switch connections at each point controlling jointly the said two local circuits at such point, whereby the display of either signal at either switchboard is determined in part by the condition of the switch connection, and in part by the operation of the polar relay at the said switchboard, such operation being responsive to signaling-currents transmitted from the other switchboard.

587,237. APPARATUS FOR TREATING DISEASES; H. Sanche, New Orleans, La. App. filed Oct. 27, 1887. A clinical instrument comprising a contact plate or member adapted to be attached to the body to be treated, a second plate or member adapted to be placed in or under the influence of a temperature higher or lower than the body to which the other plate is attached, or under the influence of matter which is electro-positive or electro-negative to the body having said other plate or member attached to it, and a flexible conducting or transmitting medium connecting said two



No. 587,163.—Multipolar Dynamo Electric Machine.

plates or members, said medium being of a relatively small size to said plates or members and of a length sufficient to permit said two plates or members to be placed at such distances apart that the body having one plate or member attached thereto will be removed beyond the range of influence transmitted by direct radiation, conduction or contact from said other plate or member.

587,260. CIRCUIT CLOSER; S. C. Houghton, San Francisco, Cal. App. filed May 14, 1897. In a circuit closer and in combination, a movable slide carrying a pivoted contact arm; a contact plate substantially parallel with the slide, a spring tending to force the arm into contact with the plate, and a pivoted and spring-pressed guard adapted to intercept and divert the arm away from the plate during the motion in one direction, but permitting it to make contact and retain such contact throughout the length of the plate during its motion in the opposite direction.

587,273. INSULATOR; H. Rudolf, Berlin, Germany. App. filed Oct. 14, 1896. An insulator for electric wires or conductors, consisting of a body portion having a head in which is formed a deep transverse groove in the bottom of which is a cavity or recess adapted to receive a bend or loop in the wire or conductor, said head being also provided with a transverse perforation, which passes through said cavity or recess and a locking-bolt which passes through said perforation, and which holds said wire or conductor in place.